EXPLORING THE IMPACT OF PROPOSED BUDGET CUTS TO NASA EDUCATION: A CASE STUDY UTILIZING QUALITATIVE DOCUMENT ANALYSIS

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Abstract: The purpose of this study was to explore the impact of proposed budget cuts on NASA's education mission broadly and on NASA's Office of Education / STEM Engagement specifically. Throughout the four years of the Trump Administration, executive budgets proposed the orderly shutdown of the Office of Education and the elimination of its suite of domestic assistance award programs. This study examined a collection of documents spanning the final two years of the Obama Administration and the entirety of the Trump Administration in order to identify potential impacts to NASA's education mission, to consider what differences could be perceived in the documentary data corpus between the Obama era Office of Education and the Trump era Office of STEM Engagement, and to attempt to understand this moment in NASA education efforts in the larger context of NASA's history. Documents examined included budget documents, materials presented to and by the NASA Advisory Council STEM Engagement Committee, and NASA Education / STEM Engagement strategic planning documents. Coding and sorting of the documents revealed shifts in NASA's education mission, resource alignment, relationships with agency and external partnerships, and assessment and strategic planning efforts. While document analysis revealed these themes and adjustments in NASA's approach to its education mission, impacts do not appear to have been as substantial as what they might have been as Congress continually overruled executive budget proposals for the past four years and the proposed shutdown never occurred.

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CHAPTER I

INTRODUCTION

The National Aeronautics and Space Administration (NASA) has explored the solar system and beyond for more than sixty years and throughout that history the agency has worked to develop America's aerospace workforce, to encourage America's youth to pursue careers in science and technology, and to inspire all of us. At the same time, NASA leadership had the forethought to establish a history office almost immediately after its inception. Telling America's story of space exploration and encouraging us to join them in those exploration efforts has always been a part of NASA's broader vision to reveal the unknown for the benefit of humanity.

NASA's inclination to maintain its historical record has provided authors and researchers with a trove of resources with which to tell the story of America's space program. That focus, however, has rarely been aimed at NASA's education efforts. As executive branch budgets throughout the presidency of Donald J. Trump called for the elimination of the NASA Office of Education and the transition to the Biden Administration remains fresh, it seems an ideal moment to consider the broad history of NASA education efforts and to attempt to place this moment in the greater arc of that story. The publicly available documents provided by NASA can be utilized to provide a perspective as to the impact of this period of uncertainty. By coding and triangulating

various budget documents, strategic planning materials, and NASA reports to its advisory council on STEM Engagement from before and during the Trump Administration, this research study attempts to gain an understanding of the path that NASA education is on, and where this transition is likely to lead.

Background of the Problem

NASA budget proposals under the Trump Administration regularly called for the defunding and orderly shutdown of the NASA Office of Education. Dramatic headlines in the news and on editorial pages, such as "Trump's NASA Budget Eliminates Education Office, Plunging America into the Dark" paint a dark portrait of what this means for NASA education and outreach efforts in the future (Siegel, 2017). Though Congress repeatedly rejected the Trump Administration's approach and continued to authorize funding for the Office of Education, some reorganization has taken place. In August 2018, the NASA Office of STEM Engagement replaced the Office of Education (National Aeronautics and Space Administration, 2019a).

The Office of STEM Engagement's flagship programs are its portfolio of domestic assistance awards. The National Space Grant College and Fellowship Program (Space Grant), Established Program to Stimulate Competitive Research (EPSCoR), and Minority University Research and Education Project (MUREP) faced elimination each time the Trump Administration resubmitted its request to eliminate this education portfolio. These programs are all funded through NASA's annual Federal appropriations. While each of these programs are designed to fulfill the mandates of various executive orders or other executive or legislative priorities, none are mandated by law and all are

subject to elimination at the pleasure of the Congress. Because these programs are designed to disseminate information and funding across a wide breadth of government, higher education, and industry, the impact of their elimination would also be felt broadly. None of the Trump Administration executive budget proposals eliminating these programs has been agreed to by the Congress as submitted; however, as these requests persisted throughout the entirety of the Trump Administration, it is necessary to understand the rationale behind the proposed change in approach as well as the significance of the reorganization which has taken place in STEM Engagement independent of budgetary decisions.

Statement of the Problem

Because multiple years of executive branch budget proposals calling for the defunding and elimination of the NASA Office of Education have created uncertainty surrounding NASA's commitment to education outreach, more research is needed to understand the present-day circumstances in NASA STEM Engagement and the impact of this budgetary uncertainty on STEM Engagement's mission and strategic direction.

Purpose of the Study

The purpose of this study was to explore the impact of the past four years of executive branch budget proposals, beginning in fiscal year 2017, that would have eliminated funding for the Office of Education / STEM Engagement by comparing various NASA education budgetary and strategic planning documents from the period just prior to and during the Trump era. This study sought to provide an understanding of

the practical impacts to STEM Engagement's mission and operations while attempting to place the moment in the larger historic arc of NASA education efforts.

Research Questions

The researcher analyzed documents specific to NASA STEM Engagement's proposed and actual budgets, NASA and NASA STEM Engagement strategic planning documents, and meeting materials documenting NASA reporting to the NASA Advisory Council (NAC) STEM Engagement Committee as well as recommendations from the NAC STEM Engagement Committee to the NAC and, by extension, the NASA Administrator in an effort to code, sort, and triangulate information from these document sources to address these research questions:

1. What impact to the mission and operations of the NASA Office of STEM Engagement from the ongoing funding disagreement between the executive and legislative branches can be perceived in NASA's documentary records from the period under study?
2. What meaningful differences can be discerned in how NASA Education / STEM Engagement described its mission, operations, and budgetary needs in the last two years of the Obama Administration in comparison to the four years of the Trump Administration?
3. How do the various proposed and implemented changes to the mission and operations of the Office of STEM Engagement relate to the broader historical mission and operations of NASA education efforts?

Significance of the Study

STEM education advocates and policy makers have questioned why the Trump Administration would seek to eliminate NASA education and there is concern about such an effort's impact on the American aerospace workforce pipeline (Bartels, 2019). There has not been a time in NASA's history in which the agency has not played an active role in the engagement, inspiration, and education of the American aerospace workforce. At the same time, these budget proposals only explicitly call for the elimination of funding for the NASA Office of Education and its domestic assistance programs. Wider NASA education efforts would not stop and the public misperception of what would and would not be impacted by these changes only serves to confuse the debate around this subject, infuse political animus, and heighten tensions.

Examination of this topic through a consolidated analysis of a variety of otherwise dispersed policy documents seeks to provide a convenient resource for STEM education advocates and policy makers as the future of NASA education continues to be debated during the early days of the Biden Administration. Additionally, it may be a tool for NASA as STEM Engagement continues to redefine its mission and NASA History seeks to document the agency's history of education efforts.

Definition of Terms

- CoSTEM – The Committee on Science, Technology, Engineering, and Math Education (CoSTEM) was established by the Obama Administration in 2011 to coordinate all Federal activities in support of STEM education (Hubbard, 2016).

- EPSCoR - The Established Program to Stimulate Competitive Research (EPSCoR) “establishes partnerships with government, higher education and industry that are designed to effect lasting improvements in a state's or region's research infrastructure, R&D capacity and hence, its national R&D competitiveness” (May, 2019b).
- Mission Directorate – NASA operations are organized into functional areas, referred to as mission directorates. The directorates include Aeronautics Research, Human Exploration and Operations, Science, and Space Technology (Dunbar, 2020).
- MUREP – The Minority University Research and Education Project (MUREP) “engages underrepresented populations through a wide variety of initiatives. Multiyear grants are awarded to assist minority institution faculty and students in research of pertinent missions” (May, 2019c).
- NAC – The NASA Advisory Council (NAC), established in 1977, is a group of subject matter experts that “provide consensus advice and make recommendations to the NASA administrator (Mochinski, 2019). These individuals are not NASA employees, but the council draws “on the expertise of its members and other sources to provide advice and make recommendations to the NASA Administrator on Agency programs, policies, plans, financial controls, and other matters pertinent to the Agency's responsibilities” (Bridenstine, 2019).
- NASA – The National Aeronautics and Space Administration (NASA) was established in 1958 as an executive branch agency tasked with planning,

directing, and conducting the United States' civilian aeronautics and space activities ("National Aeronautics and Space Act," 1958).

- NASA Advisory Council STEM Engagement Committee – One of six standing committees of the NASA Advisory Council (Mochinski, 2020). This body serves an advisory and oversight role for NASA education and makes committee recommendations to the NAC specific to NASA STEM engagement efforts.
- NASA Centers – NASA operations are spread across various facilities throughout the United States, referred to as "Centers" or "Field Centers". Major NASA centers include Ames Research Center, Armstrong Flight Research Center, Glenn Research Center, Goddard Space Flight Center, Jackson Headquarters, Jet Propulsion Laboratory, Johnson Space Center, Kennedy Space Center, Langley Research Center, Marshall Space Flight Center, and Stennis Space Center (Dunbar, 2020).
- NASA education / NASA Education / NASA STEM Engagement – For the purposes of this research study "NASA education" refers broadly to all NASA education efforts across directorates, centers and offices. "NASA Education" or "Office of Education" refers to the Jackson Headquarters based NASA Office of Education. "NASA STEM Engagement" or "Office of STEM Engagement" refers to the Jackson Headquarters based Office of STEM Engagement, reorganized to replace the Office of Education in 2018.
- Next Gen STEM – Next Gen STEM is a series of products and activities developed by the NASA Office of STEM Engagement, intended to engage

students in efforts that contribute to NASA's mission of exploration and discovery (May, 2019d).

- SEAP – The STEM Education and Accountability Projects (SEAP) were Obama era NASA programs intended to "provide competitive opportunities to support innovative education efforts at NASA centers, facilities, and other partners (National Aeronautics and Space Administration, 2015b, p. 51).
- Space Grant – The National Space Grant College and Fellowship Program, referred to as "Space Grant" is a network of colleges and universities across the United States "working to expand opportunities for Americans to understand and participate in NASA's aeronautics and space projects by supporting and enhancing science and engineering education, research and public outreach efforts" (May, 2018).
- STEM Education Programs – The United States Department of Education (2007) describes STEM education programs as any elementary, secondary through postgraduate, or adult education programs intended to support or strengthen study in the fields of science, technology, engineering, or mathematics.

Theoretical Perspective

This research was qualitative in nature, utilizing document analysis to explore NASA STEM Engagement budget documents, strategic planning documents, and reports to and by the NAC STEM Engagement Committee in order to identify themes in the documents as well as potential shifts from late years of the Obama Administration through the four years of the Trump Administration. This research was conducted considering the history, culture, and purpose of the NASA Office of STEM Engagement

in order to develop a case study exploring the impact of budgetary and organizational changes on STEM Engagement in the Trump era. Case study as a methodology is an "in-depth exploration, from multiple perspectives of the richness and complexity of a bounded social phenomenon" (Bloomberg & Volpe, 2008, p. 49). Stake (2005), on the other hand, describes case study not as a methodology, but as a choice of subject matter to be studied.

Case study research is described as particularistic, descriptive, and heuristic (Mills & Gay, 2019). To be particularistic is to be focused on a singular event or phenomenon. In this case, the particular phenomenon under study was the bounded period of time representing the transition of NASA Education under the Obama Administration to the organizational change and budgetary uncertainty of NASA STEM Engagement under the Trump Administration, 2015-2020. To be descriptive means that the end result of the research provides a description of the phenomenon under study. This research resulted in findings which inform the researcher's description of the impacts of the particular phenomenon to the extent that those impacts could be identified in NASA's documentary records using the research methodology selected. In order for research to be heuristic, a case study should "illuminate the reader's understanding of the phenomenon under study" (Merriam, 1998, p. 30). A case study should expand the reader's knowledge of a particular subject. By consolidating, coding, sorting, and triangulating various document sources, this research sought to illuminate key issues regarding NASA STEM Engagement's operations and strategic direction.

Document analysis is a method of reviewing and evaluating a collection of documentary materials, whether they be physical or digital (Bowen, 2009). The process

of document analysis involves the identification of excerpts or entire passages of material that can be coded into categories and major themes through the process of content analysis (Labuschagne, 2003). Bowen (2009) identifies five primary uses for document analysis; documents can provide context for additional research, documents can suggest questions or situations in the research that need further exploration, documents can provide supplementary research data, documents can provide a means of tracking change over time, and documents can be used to corroborate or verify findings. In this research study, document analysis was used primarily to explore change over time, exploring the shifts in documentation between two presidential administrations, as well as to explore the alignment between NASA STEM Engagement's publicly stated mission and objectives and the Trump Administration's proposed budget cuts.

While the use of document analysis as a stand-alone research method is somewhat rare in educational research, it can be utilized as such in particular settings or from necessity. Historical and cross-cultural research often rely on prior studies and primary documents as these may be the only method of conducting such research (Merriam, 1988). In an interpretive paradigm, such as hermeneutic inquiry, documents may be the only necessary source of data (Bowen, 2009). In this research study, the lack of access to NASA personnel limited the researcher's ability to gather other forms of qualitative or quantitative data, making document analysis the necessary avenue of inquiry to explore the research questions posed. The process of coding and analyzing government documents produced for purposes other than research also required some interpretation on the part of the researcher, combining necessity with some characteristics of hermeneutic inquiry.

NASA STEM Engagement has experienced, and perhaps continues to experience, a period of transition due to threats to its operating budget and its recent rebranding and refocusing (Foust, 2017). A case study, featuring an in-depth examination of a trio of information sources; budgetary records, strategic planning documents, and reports to and by the NAC STEM Engagement Committee, sought to provide an opportunity to identify themes that may have developed during the Trump Administration. This qualitative analysis of the documentary record, focused on the tumultuous Trump era in comparison with the period preceding it, combined with the researcher's own examination of the history of NASA's education efforts, sought to reveal themes that shed light on how well NASA STEM Engagement has navigated such a fraught political environment and the findings and conclusions drawn attempted to recognize clues as to STEM Engagement's strategic direction moving forward under President Joe Biden's leadership.

Assumptions

Conducting a case study utilizing qualitative document analysis to seek an understanding of the impact of potential budget cuts and organizational change in NASA education necessitates some basic assumptions about the data being analyzed:

1. It was assumed that coding and triangulation of data across three distinct document types; budget documents, strategic planning documents, and reports to and by the NAC STEM Engagement Committee would provide sufficient information from which to draw inferences, identify themes, and to reach conclusions about the period of organizational change during the Trump era in NASA STEM Engagement.

2. It was assumed that, despite the transition to the Biden Administration, the necessary NASA documents produced during both the Obama and Trump Administrations, publicly available at the time of this study's proposal and essential to the document analysis process utilized, would remain publicly available and accessible throughout the duration of this research.
3. Because the organizational and budgetary changes and proposed changes coincided with a new presidential administration and leadership changes within NASA, it was assumed that political biases might play a role in the manner in which information was presented as well as the researcher's interpretation of data. Trustworthiness and credibility of data collection and analysis has been addressed in a later section.

Limitations

Case studies are intended to provide an in-depth exploration of a phenomenon from multiple perspectives (Bloomberg & Volpe, 2008). The researcher's initial intent was to conduct semi-structured interviews with STEM Engagement professionals in order to combine document analysis and phenomenological research to form a more robust picture of the impacts of the Trump era on NASA education efforts. Following months of effort, the researcher was unable to achieve sufficient participation among the civil servant and contractor workforces in NASA STEM Engagement to pursue this avenue of inquiry.

This research design was modified to broaden the scope of document analysis to become the primary source of research data. The research questions were considered

from multiple angles across multiple document types. As Merriam (1988, p. 118) observed, “Documents of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem.” No amount of document analysis can, however, replace the insights gained from participant observation or interaction. Bowen (2009) identifies lack of detail (documents are likely created for purposes other than research and therefor leave out content valuable to a research agenda) and biased selectivity (availability of documents usually aligns with corporate priorities) as additional limitations of document analysis. Further research will be necessary to learn more about the lived experiences of the education professionals working in this field during this period in NASA education’s history and to fill in what the documentary record alone cannot.

Delimitations

As previously referenced, qualitative interviews with education professionals working for and with NASA STEM Engagement would likely provide a more complete data set from which to draw conclusions about this period of organizational change in NASA Education / STEM Engagement. The researcher’s original research design called for triangulation of document analysis, a review of literature, and participant perceptions to conduct a phenomenological study. The researcher was unable to obtain enough participation for the study to move forward.

Additionally, a widely distributed quantitative survey might produce a more representative result that would allow for generalization across NASA or might provide a researcher with enough data to draw some conclusions about variation of perceptions of

NASA education at the various NASA centers. Both of these approaches would have to contend with the reluctance to engage with questions surrounding the transition from NASA Education to STEM Engagement experienced by the researcher.

Summary

This chapter laid out the reasoning for the pursuit of this research study. Background was provided regarding NASA education efforts and the budgetary environment which generated uncertainty surrounding NASA's education mission during the Trump presidency. The purpose and significance of the study was described and the theoretical framework within which this research was to be conducted was also detailed. Finally, assumptions, limitations, and delimitations of the research study were discussed.

CHAPTER II

REVIEW OF LITERATURE

Introduction

To understand the recent transitional environment within NASA education broadly and the Office of STEM Engagement specifically, it is important to understand the wider context in which that transition has taken place. This review of literature seeks to provide such historical context within which decisions regarding NASA's education budget and mission are being made. This review of literature focuses on three aspects of NASA education efforts:

1. The review of literature will provide a broad overview of NASA's education efforts and organizational structure throughout its more than sixty-year history. This overview does not seek to be an all-encompassing historical record of all NASA education efforts, but instead will highlight educational activities throughout NASA's more than sixty-year history in an effort to identify trends or themes in the broad view of NASA education.
2. The review of literature will provide a historic look at the evolution of NASA's education mission over time.

3. The review of literature will explore documentation of the recent past to illuminate details of the changing budgetary environment during President Donald Trump's term in office as well as the transition of the NASA Office of Education to the Office of STEM Engagement.

NASA Education History

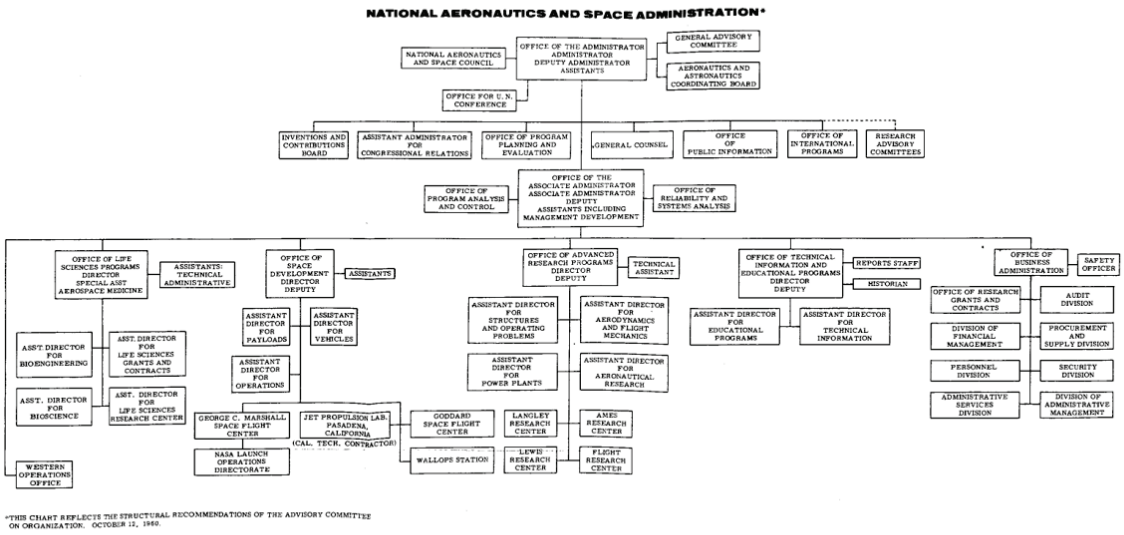
At its founding, NASA was tasked with a broader role than just the advancement of aviation and space flight. The agency was also to share knowledge gained through its endeavors to the wider American population. The National Aeronautics and Space Act (1958) established that a foundational component of NASA's mission was to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof". From early in its development, NASA's approach to educational outreach was to consolidate those activities into a coordinating office at NASA Headquarters. To provide a greater focus on the Space Act requirement that NASA disseminate information concerning its activities, the agency formed the Office of Technical Information and Educational Programs in May 1960 (Rosholt, 1966). Figure 1 details NASA's organizational structure at that time.

A prominent educational tool employed in the 1960s was "NASA employee delivered presentations to students of all ages via 'Spacemobile' panel trucks carrying" a variety of resources including models, science experiments, and other visual aids (Curry, 2010, p. 174). NASA personnel worked with teachers to develop curriculum, sponsored extension courses for high-school teachers and other interested adults, and encouraged space themed research in settings like science fairs (Curry, 2010). At this early stage of

NASA educational outreach, the agency also established the precedent of joint management of education efforts in partnership with contractors in fields such as higher education. The aforementioned Spacemobile program, for example, was administered by Oklahoma State University from 1969 until 1975 (Oklahoma State University College of Education, 1996).

Figure 1

NASA Organizational Chart, October 1960



Note. Taken from "NASA Organizational Charts," by S. Garber, 2015. Retrieved from https://history.nasa.gov/orgcharts/orgcharts.html

In parallel to these early efforts in broad education outreach, the need for NASA to engage with higher education in research and development became apparent as the Apollo program began to take shape in response to President John F. Kennedy's challenge that America land astronauts on the Moon and return them to the Earth by the end of the 1960s. Writing in December 1961, NASA Administrator James Webb described the agency's relationship with America's universities:

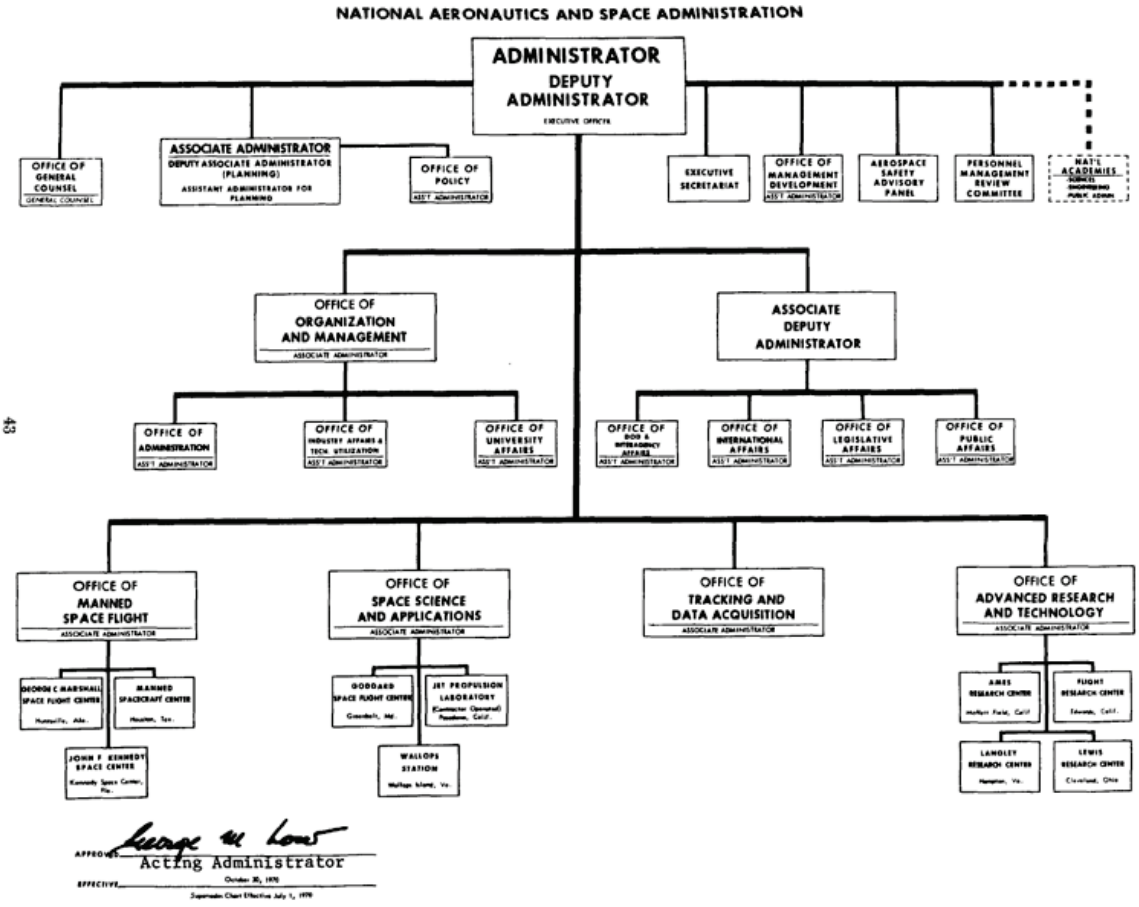
> Space science and technology represent frontier areas not now taught as such in universities… NASA needs people highly trained in these areas. These people are needed not only within the NASA organization, but also in the industrial concerns participating in the NASA program… In order to obtain the needed personnel NASA must help provide the universities with resources needed to produce them (Lambright & Bock, 1969, p. VII 3).

Administrator Webb envisioned a space program that would not only win a space race, but that would benefit America in research, education, and economic development (Lambright, 1995). To that end, NASA established the Sustaining University Program (SUP), an early attempt to develop talent and research in higher education through trainee programs as well as research and facilities grants (Lambright & Bock, 1969). Though the SUP faded and was discontinued by the late 1960s, the program established educational relationships across the country, generating NASA trainees "in universities and colleges of almost every state of the Union" (Newell, 2010, pp. 226-227). This approach of spreading resources across the United States and building a network of affiliated institutions, whether through efforts like the SUP or with partnerships like the Spacemobile program, laid the groundwork for an approach that shapes NASA education efforts in higher education to this day.

It was during this era of the mid to late 1960s and into the new decade of the 1970s that NASA's organizational focus on university outreach reached a zenith, with a stand-alone Office of University Affairs, though it also faded from NASA's organizational charts as Apollo drew to a close (Garber, 2015). Figure 2 details NASA's organizational structure in October, 1970.

Figure 2

NASA Organizational Chart, October 1970



Note. Taken from "NASA Organizational Charts," by S. Garber, 2015. Retrieved from https://history.nasa.gov/orgcharts/orgcharts.html

Education outreach efforts of the 1970s and 80s continued to evolve and expand. It was also during this period that more education efforts began to be tied more specifically to particular missions or directorates. In the 1970s, for example, NASA engaged high school students by accepting proposals for experiments to be performed aboard Skylab. Students selected to participate were involved in planning and development as well as analysis of data returned to Earth (Summerlin, 1977).

When Christa McAuliffe was selected for the Teacher in Space Program in 1985, the majority of her planned time with NASA was to serve in an educational outreach capacity in public relations and as a liaison to educators (Cohn, 1985). The Teacher in Space Program itself was conceived as an effort to inspire students and to generate fresh interest in STEM subjects (Brown, 2018a). The program was suspended indefinitely following McAuliffe's death in the Space Shuttle Challenger disaster in 1986 but would resume decades later.

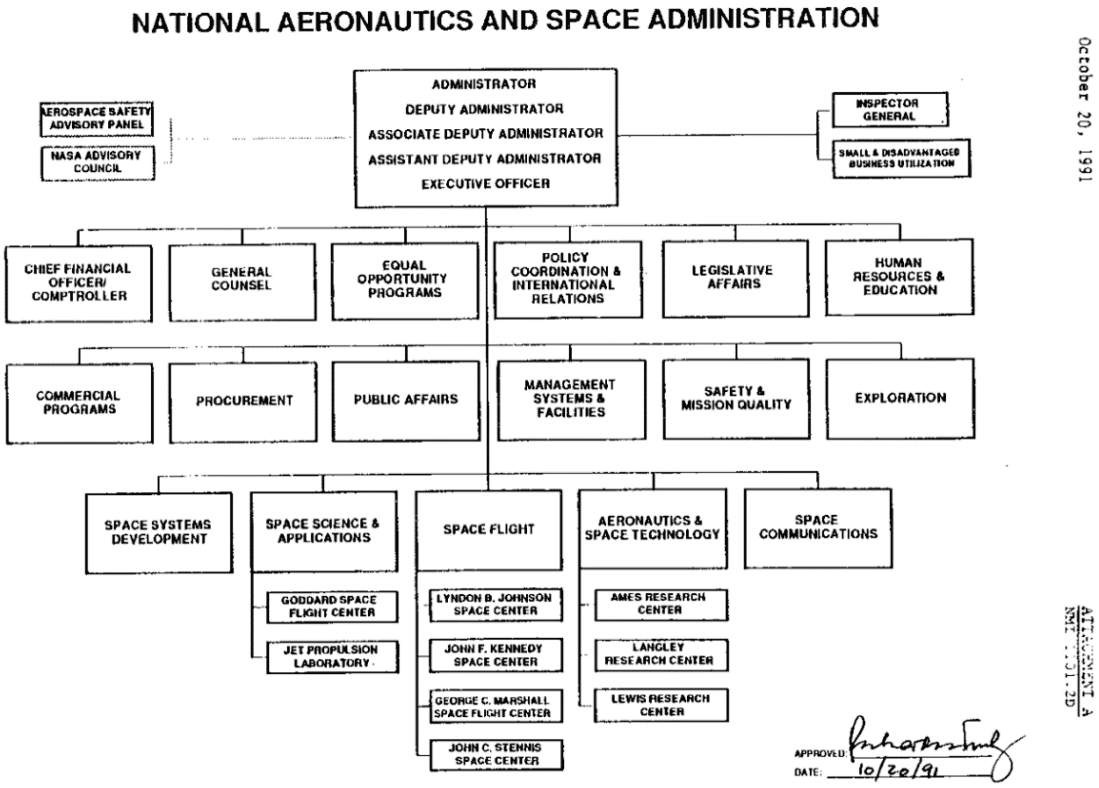
University partnerships, though somewhat diminished from their Apollo peak, continued throughout the 1970s and 80s as well. Programs like the Aerospace Education Services Project and the NASA Teaching from Space contract (distinct from the human space flight based "Teacher in Space" program) represented millions of dollars in funding for universities to provide contracted support to NASA (Oklahoma State University College of Education, 1996). Such programs provided education specialists who could travel from NASA Headquarters and the various field centers to provide presentations and training to classrooms and teachers, introducing NASA content into the K-12 learning environment (Oklahoma State University College of Education, 1996).

In October 1991, education programs were placed under the Office of "Human Resources and Education" (Garber, 2015). While education would remain embedded within human resources / human capital for the next decade, the modern form of NASA educational efforts did not take shape until the establishment of the Office of Education (OE) in 1993, with most prior organizational efforts focused on education and outreach tied to individual missions and directorates (Ivie, 2009). It was during this modern period that OE's portfolio of domestic assistance awards, Space Grant, MUREP, and EPSCoR,

were consolidated under one organizational umbrella (National Aeronautics and Space Administration, 1992). Figure 3 illustrates Education's place in NASA's organizational chart in October, 1991, shortly before this reorganization.

Figure 3

NASA Organizational Chart, October 1991



Note. Taken from "NASA Organizational Charts," by S. Garber, 2015. Retrieved from https://history.nasa.gov/orgcharts/orgcharts.html

It was also during this period of the 1990s and 2000s that NASA again placed an emphasis on university partnerships by establishing Educator Resource Centers across the United States. Such centers provided educators access to "publications, books, classroom activities, posters, color lithographs, videotapes, slides, filmstrip/audio programs, and computer software" (Oklahoma State University College of Education, 1996, p. 21).

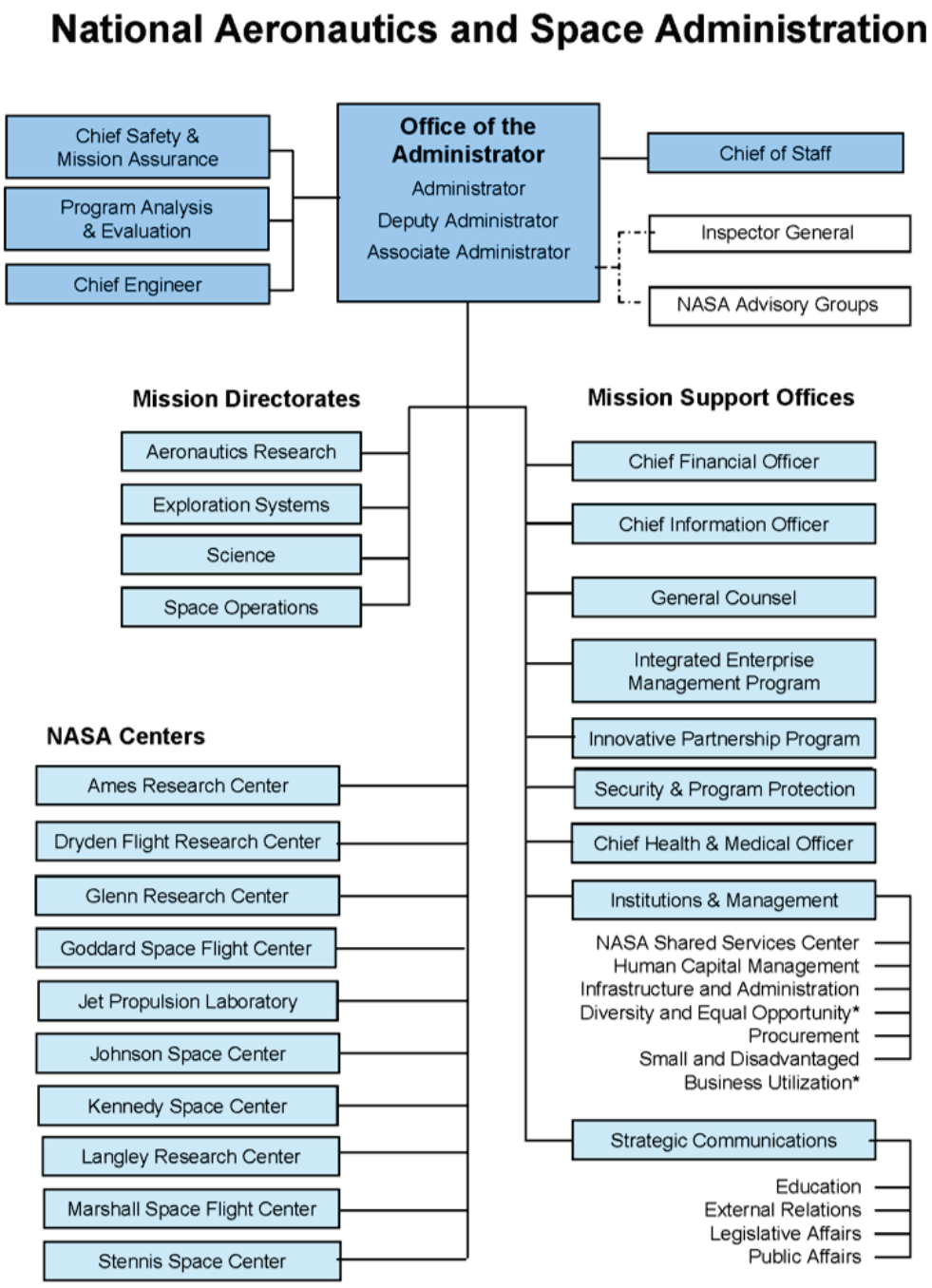
NASA still provides access to an archived website listing an Educator Resource Center network stretching across 71 centers in 53 states and territories (National Aeronautics and Space Administration, n.d.). The Educator Resource Center Network has since been eliminated and NASA directs those seeking resources to NASA web sites and field centers (May, 2019a). At their peak, however, centers such as the Aerospace and Environmental Education Resource Center at Eastern Connecticut State University offered "innovative ways to teach the atmospheric and earth sciences and mathematical concepts while offering a partnership with far-reaching implications by exposing [students] to the opportunities in the aerospace industry" (Papazian, 1996, p. 13).

Also, in the 1990s and 2000s, the later stages of the space shuttle era provided numerous opportunities to involve students in STEM learning and NASA / university partnerships often played a leading role. The University of Nebraska at Omaha provided one such example, utilizing a mock space shuttle to engage students' problem-solving using math, science, and computer skills (Holloway, 1998). Students were able to participate in simulated missions and were able to interact with the shuttle in real time, in one instance controlling a camera aboard the shuttle during a Mir replenishment mission (Holloway, 1998).

During the George W. Bush Administration, the Office of Education shifted its administrative home twice, first breaking from the Office of Human Capital to become a stand-alone, enterprise level office in 2001 and then moving under the new Office of Strategic Communications in 2005 (Hubbard, 2016). Figure 4 describes NASA's organizational structure in October, 2006, shortly after this change.

Figure 4

NASA Organizational Chart, February 2006



Note. Taken from "NASA Organizational Charts," by S. Garber, 2015. Retrieved from https://history.nasa.gov/orgcharts/orgcharts.html

In 2002, NASA administrator Sean O'Keefe announced the agency's commitment to fulfill Christa McAuliffe's mission by finally sending a teacher to space with the intent of expanding the program to include other teachers who would work to develop new space-based education programs (Leary, 2002). The Teacher in Space program was again delayed by the Columbia disaster of 2003 but Barbara Morgan finally became the first teacher in space aboard the Space Shuttle Endeavour in August 2007 (Morgan, 2010). In 2018, the Office of STEM Engagement worked with the Challenger Center and International Space Station astronauts Ricky Arnold and Joe Acaba to both bookend the Teacher in Space program and to honor Christa McAuliffe by conducting lessons aboard the station based on McAuliffe's lesson plans from the original Challenger mission (Brown, 2018a).

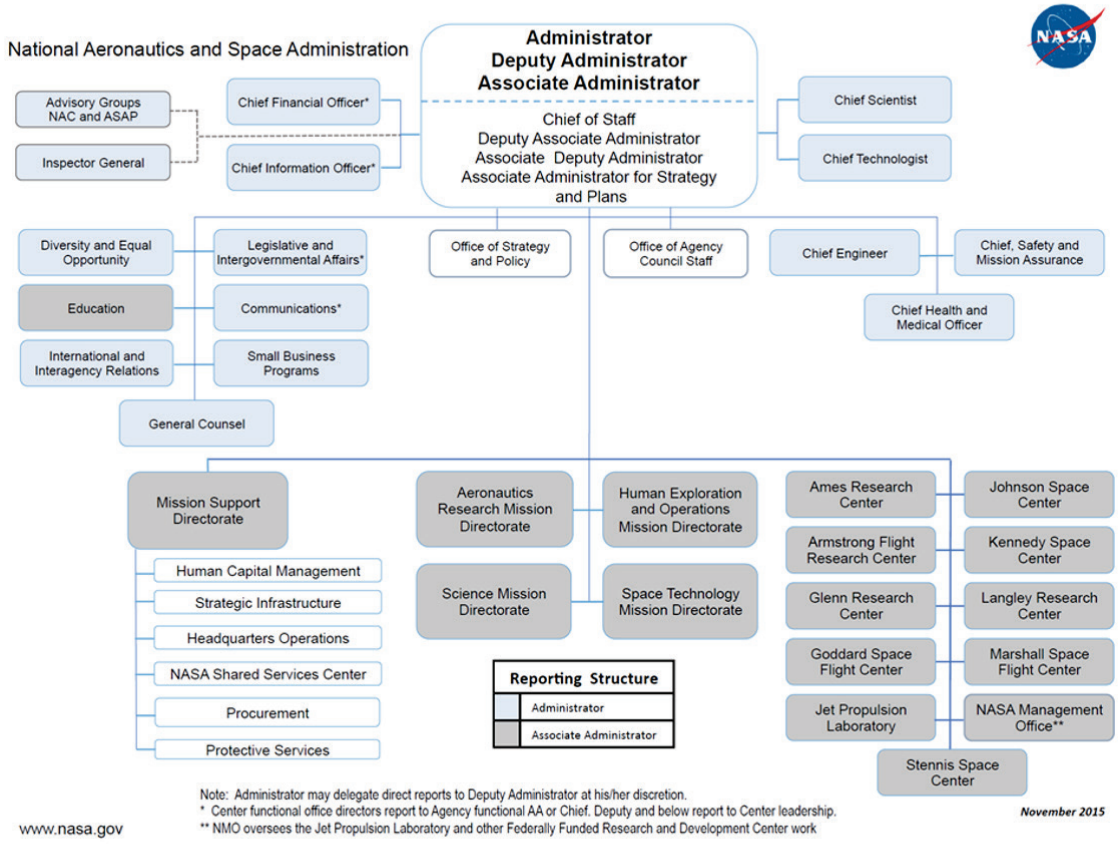
Even with an intent to organize educational efforts under the umbrella of the Office of Education, education outreach efforts across centers and mission directorates continued to be expansive and hard to analyze. Under the Obama Administration, there was a refocused effort to utilize the Office of Education as a unifying structure at the center of all of these activities and to align OE's efforts with the goals set forward by the Committee on STEM Education (CoSTEM), a committee established in 2011 to coordinate all Federal STEM education efforts across government (Hubbard, 2016).

By 2015, the NASA Office of Education was intended to serve as a hub that provided a unified approach to data collection and performance assessment across all NASA education activities (National Aeronautics and Space Administration, 2015b). As the Obama presidency drew to a close, OE was once again an enterprise level office

within the NASA organizational structure, reporting to the Associate Administrator (Garber, 2015). Figure 5 illustrates NASA's organizational structure at that time.

Figure 5

NASA Organizational Chart, November 2015



Note. Taken from "NASA Organizational Charts," by S. Garber, 2015. Retrieved from https://history.nasa.gov/orgcharts/orgcharts.html

Mission of NASA Education

Early agency history suggests a NASA education mission that has remained largely consistent with modern goals. By 1964, the NASA Educational Programs and Services Office sought to encourage space science education by developing scientific literacy and providing space science enrichment materials for elementary, secondary, and

teacher training programs (Bernardo, 1964). Further, "NASA's desire to work with universities as institutions was part of a broad attempt to strengthen the scientific and engineering resources of the country able to work in aeronautics and space" (Lambright & Bock, 1969, pp. I-3 - I-4).

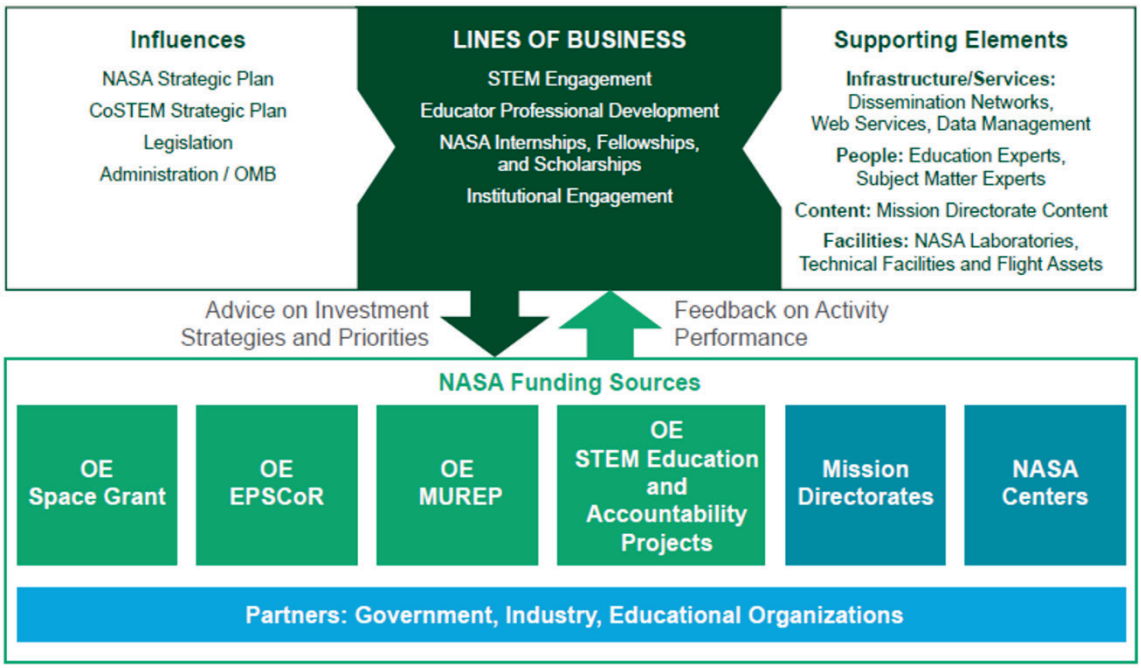
NASA's education vision in 1992 was "to promote excellence in America's education system through enhancing and expanding scientific and technical competence" (National Aeronautics and Space Administration, 1992, p. 11). Goal's included maintenance of NASA's core education programs, implementation of new reform initiatives judged to address NASA mission requirements, and to significantly expand partnerships with external constituencies (National Aeronautics and Space Administration, 1992).

NASA's education goals in 2008 remained consistent with mission objectives as far back as the 1960s and included strengthening the STEM workforce, attracting students to STEM disciplines, and engaging Americans in NASA's mission (National Aeronautics and Space Administration, 2008). In 2009, the Office of Education included a K-12 division and a higher education division, both whose overall goal was to "inspire, identify, and then train / mentor potential students who can move into specific career fields" (Allner et al., 2010, p. 1281). In 2011, NASA's Education Design Team recommended the establishment of a structure that would provide a strategically integrated portfolio across the Office of Education, Centers, and Mission Directorates (NASA Education Design Team, 2011).

In 2015, on the cusp of an approaching presidential transition and the coming shift in NASA's approach to a centralized Office of Education, NASA's education mission was stated simply, "to advance high quality STEM education using NASA's unique capabilities" (National Aeronautics and Space Administration, 2015b, p. 6). OE pursued this mission utilizing four lines of business, or areas of focus, including STEM Engagement, Educator Professional Development, NASA Internships, Fellowships, and Scholarships, and Institutional Engagement. Figure 6, taken from NASA's Education Implementation Plan 2015-2017, illustrates this operational architecture.

Figure 6

NASA Office of Education Architecture, 2015



Note. Taken from NASA Education Implementation Plan 2015-2017. Retrieved from https://www.nasa.gov/feature/nasa-education-implementation-plan-2015-2017/

The Office of STEM Engagement's mission in 2019 was to "deliver tools for young Americans and educators to learn and succeed" (May, 2019a). STEM

Engagement's stated goals were to create unique opportunities for students to contribute to exploration, to build a diverse STEM workforce by engaging students in learning experiences utilizing NASA assets, and to strengthen public understanding of NASA's mission (May, 2019a).

> To achieve these goals, NASA STEM Engagement strives to increase K-12 involvement in NASA projects, enhance higher education, support underrepresented communities, strengthen online education, and boost NASA's contribution to informal education. The intended outcome is a generation prepared to code, calculate, design, and discover its way to a new era of American innovation (May, 2019a).

Throughout the Trump era, the Office of Education / STEM Engagement underwent numerous structural changes, but its place in NASA's organizational structure remained largely unchanged from the previous administration. As of August 2020, STEM Engagement remained an enterprise level office and reported through an associate administrator for STEM Engagement up to Administrator Jim Bridenstine (Dunbar, 2020). Figure 7 illustrates NASA's organizational structure in August, 2020, just prior to the 2020 election and the beginning of the Biden presidential transition.

Transition in NASA Education / STEM Engagement

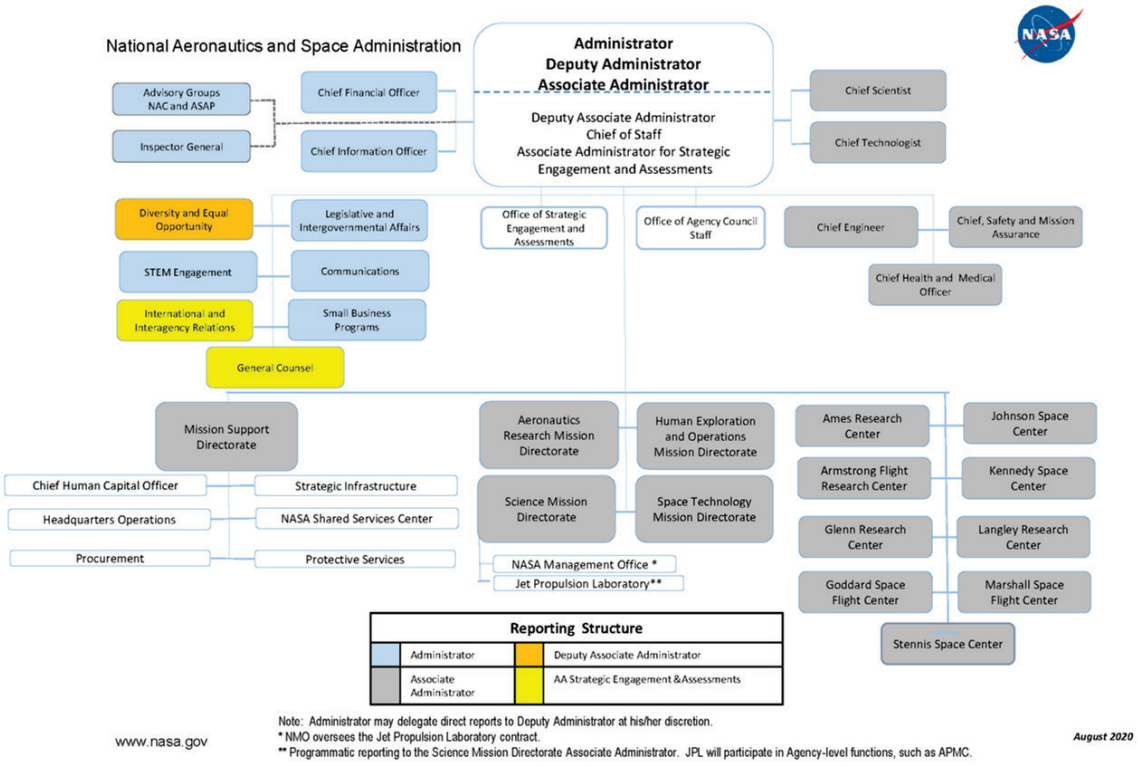
The last budget proposal under the Obama Administration called for a continued expansion of the roles and responsibilities of the Office of Education. The President's FY 17 budget request described an effort to consolidate education "functions, assets, and

efforts" under the Office of Education (National Aeronautics and Space Administration, 2016, p. EDUC 4). This executive budget proposal asserted:

> NASA's education programs develop and deliver activities that support the growth of the Agency's and the Nation's STEM workforce, help develop STEM educators, engage and establish partnership with institutions, and inspire and educate the public. The Nation's economic competitiveness and the path to the American dream depends on providing all children with an education that will enable them to succeed in a global economy (National Aeronautics and Space Administration, 2016, p. EDUC 3).

Figure 7

NASA Organizational Chart, August 2020



Note. Taken from "NASA Organization Structure," by B. Dunbar, 2020. Retrieved from https://www.nasa.gov/about/org_index.html

By FY 18, NASA's budget request had changed dramatically, calling for the orderly closeout of the Office of Education:

> While output data (e.g., number of people funded, number of papers generated, number of events supported) has been tracked, outcome-related data demonstrating program effectiveness has been insufficient to assess the impact of the overall OE portfolio (National Aeronautics and Space Administration, 2017, p. EDUC 2).

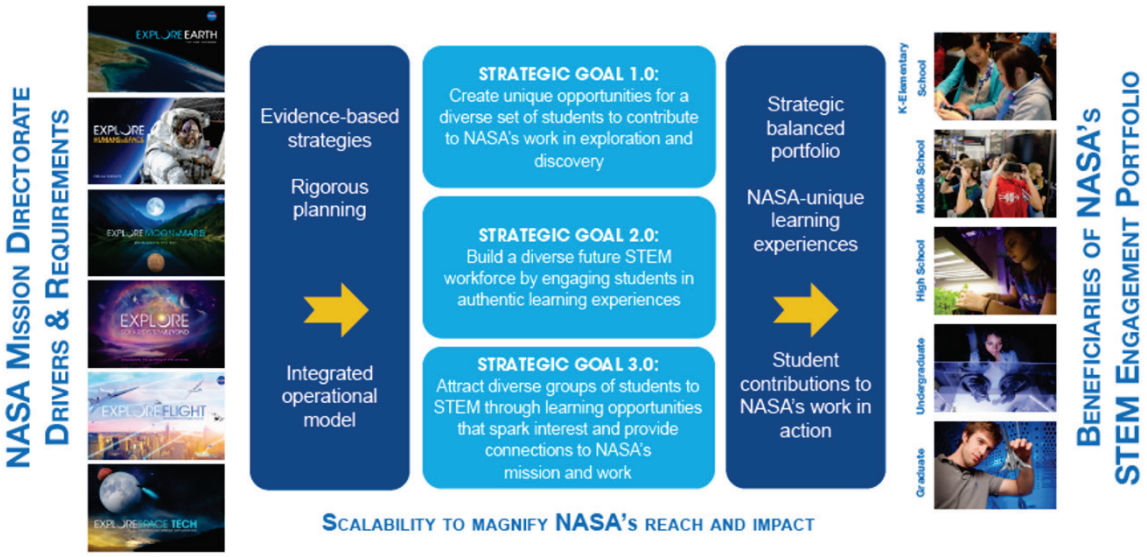
Despite advocating for this closeout, which would wind down Space Grant, MUREP, and EPSCoR, NASA and the Trump Administration continued to promote the Office of Education's positive role in education outreach. In December 2018, the National Science and Technology Council continued to tout NASA STEM Engagement's Space Grant and Fellowship Program as a source of innovative transdisciplinary learning (Committee on STEM Education, 2018). In announcing NASA's commitment to the White House's STEM strategy, Administrator Jim Bridenstine stated, "STEM education is vital to everything we do at NASA", and went on to say that NASA is "committed to, and dependent upon, inspiring future generations of STEM leaders" (Brown, 2018b). Figure 8 illustrates the Office of STEM Engagement's operational architecture as laid out in its 2020 Strategy for STEM Engagement.

The President's FY 2020 budget request listed accomplishments and work in progress for NASA's EPSCoR, MUREP, Next Gen STEM, and Space Grant programs while simultaneously calling for their defunding (National Aeronautics and Space Administration, 2019a). The seeming disconnect between stated intentions and executive

budget priorities suggests that further inquiry is necessary to understand the Agency's vision for NASA education efforts. It is also this incongruity that led the researcher to the development of the research questions at the core of this study.

Figure 8

NASA Office of STEM Engagement Architecture, 2020



Note. Taken from NASA Strategy for Science, Technology, Engineering and Math (STEM) Engagement 2020 - 2023. Retrieved from https://www.nasa.gov/sites/default/files/atoms/files/nasa-strategy-for-stem-2020-23-508.pdf

Summary

The literature suggests a largely consistent vision and mission for NASA education efforts over time. Organizational structure has shifted and there have been numerous attempts to consolidate education efforts under an umbrella organization but these fluctuations do not suggest radical changes to vision and mission. NASA has a long history of engaging external partners, including higher education, to strengthen its education mission with goals centered on the strengthening of the American workforce and the expansion of knowledge among American youth.

Recent budget proposals calling for the defunding of a centralized education office and of domestic assistance programs designed to engage institutions, students, and technological innovators appear to be incongruous with the broad arc of historic educational efforts. This study seeks to contribute clarity to the relationship between the Office of STEM Engagement's mission and executive budget proposals of the Trump presidency.

CHAPTER III

METHODOLOGY

Introduction

This chapter addresses the design of this research study. Data collection methods will be detailed and the primary data sources will be defined and described. This chapter will also include considerations of trustworthiness, credibility, and reflexivity in relation to the proposed study.

The purpose of this study was to utilize documentary evidence to explore the impact of Trump era executive budget proposals on NASA education efforts broadly and on the mission and operations of NASA's Office of Education / STEM Engagement specifically. Research questions to be addressed include:

1. What impact to the mission and operations of the NASA Office of STEM Engagement from the ongoing funding disagreement between the executive and legislative branches can be perceived in NASA's documentary records from the period under study?
2. What meaningful differences can be discerned in how NASA Education / STEM Engagement described its mission, operations, and budgetary needs in the last two

years of the Obama Administration in comparison to the four years of the Trump Administration?

3. How do the various proposed and implemented changes to the mission and operations of the Office of STEM Engagement relate to the broader historical mission and operations of NASA education efforts?

Research Design

This study utilized publicly available documents, published on NASA websites. The researcher collected and analyzed budget documents, strategic planning documents, and NASA reports to and by the NAC STEM Engagement Committee. The documents examined covered the time period of 2015 through 2020, providing materials from the latter part of President Obama's second term in office and the entirety of President Trump's term in office. The particular time period selected was based upon availability of documents and the desire to triangulate results across document types for an equivalent period. While budget and strategic planning documents were available to allow for a wider time range, NAC STEM Engagement committee materials were only available beginning in 2015. All of these documents were then examined and structural coding and thematic sorting provided results that could be compared in an attempt to address the research questions posed.

Data Collection

The data collection method utilized in this study was document collection, review, and analysis. The documents were downloaded from various subsections of the NASA.gov website and were then uploaded into the qualitative data analysis software

QDA Miner Lite, installed locally on the researcher's computer, where their contents could be categorized for analysis. The documents collected for analysis consisted of three categories of material:

1. Sections of NASA's annual executive budget proposals submitted to Congress, specific to NASA Education / STEM Engagement. The following documents were included for purposes of analysis:
    a. FY 2016 Budget Estimates
    b. FY 2017 Budget Estimates
    c. FY 2018 Budget Estimates
    d. FY 2019 Budget Estimates
    e. FY 2020 Budget Estimates
    f. FY 2021 Budget Estimates
2. NASA Education / STEM Engagement strategic planning and implementation documents covering the period under study, to include:
    a. NASA Education Implementation Plan: 2015-2017
    b. NASA Strategy for Science, Technology, Engineering and Math (STEM) Engagement: 2018-2020
    c. NASA Strategy for STEM Engagement: 2020-2023
3. A collection of meeting agendas, meeting minutes, and presentation materials of the NASA Advisory Council STEM Engagement Committee ranging from April 2015 to October 2020, as well as a series of NASA Advisory Council recommendations and NASA responses to those recommendations from the same time period. A full list of the NAC STEM Engagement Committee documents and

NAC recommendation documents included in the document analysis, as well as the listed budget and strategic planning documents above, is available in Appendix A.

These document sets were chosen to consider the research questions posed from multiple perspectives. Executive budget documents provide for what NASA, under each administration, requested from Congress, shedding some light on the agency's intent for its own education efforts. Strategic planning documents provide insight as to how NASA Education / STEM Engagement proposed to go about its mission under the operating conditions as they were or were anticipated to be. Proceedings from the NAC STEM Engagement Committee detail how NASA Education / STEM Engagement communicated its intentions to an external oversight body. Qualitative research is expected to utilize multiple sources of information in order to seek corroboration and convergence of data (Bowen, 2009). Otherwise lacking access to NASA personnel in order to supplement this study with interviews, observation, etc., the researcher attempted to utilize these multiple documentary perspectives in order to generate conditions that allowed for triangulation to enhance the trustworthiness of any findings.

Trustworthiness. Lincoln and Guba (1985) define trustworthiness as research with significance and value. Trustworthiness can be established by evaluating the credibility, transferability, dependability, and confirmability of the research (Guba, 1981). Bloomberg and Volpe (2008) describe credibility as a criterion that identifies whether the researcher's portrayal of findings accurately represents the subject of the study. Addressing reflexivity is one mechanism for strengthening credibility (Bloomberg & Volpe, 2008). Because these implemented and proposed changes have taken place in a

politically charged environment and proposed changes by the Trump executive branch have been viewed negatively in media accounts, the researcher has disclosed any self-perceived biases in a discussion of reflexivity in this study. Additionally, the researcher has shared any discrepant findings that emerged during the course of the research study. Reflexivity will be discussed in further detail in a following section.

Additionally, thick description and in-depth engagement can further strengthen credibility as well as transferability (Bloomberg & Volpe, 2008). The researcher attempted to demonstrate these characteristics in this research study by detailing the coding and analysis process and the iterations that developed during those processes, as well as by exploring multiple document groups from multiple perspectives. Dependability, confirmability, and credibility can also be addressed through peer debriefing and examination as well as by triangulation. Patton (2015) describes peer debriefing as a process intended to improve the accuracy of a described phenomenon. A peer reviewer was identified and engaged to review progress and to ask questions of the researcher to promote an examination of assumptions and alternate perspectives. Triangulation was utilized by comparing the coding emerging from the varying document groups to each of the other groups as well as to other government documents and media accounts of events during the period under study utilized in the review of literature. Bloomberg and Volpe (2008) describe triangulation as a method that aids researchers in assessing the validity of their interpretation of collected data.

Reflexivity. Reflexivity refers to a process "emphasizing the importance of deep introspection, political consciousness, cultural awareness, and ownership of one's perspective" (Patton, 2013, p. 242). The idea that the Trump Administration would

defund NASA education elicits a visceral response. The reality, however, is that this is a more complicated issue than that presented in media accounts and social media posts. While NASA's FY 18 budget proposal advocated the outright closure of the Office of Education, subsequent budget requests have suggested that it would be replaced by another functional office and that only its portfolio of domestic assistance awards would be lost.

The impact of those losses, however, would be significant and widespread. Concern for the state of NASA education efforts shaped the focus of this study and it is anticipated that the researcher's method of data analysis will take a more hermeneutic approach. Valentine, Kopcha, and Vagle (2018) describe interpretation of data in hermeneutic phenomenology as a series of iterative cycles in which the researcher restrains but also acknowledges their part in understanding the phenomenon under study.

The researcher remains fundamentally opposed to the budgetary direction for the Office of STEM Engagement advocated by the Trump Administration and the researcher's experiences and perceptions likely shaped the lens through which the researcher viewed the data collected. As an administrator and instructor in a higher education setting for almost twenty years and as an individual with an educational background in both history and education, the researcher's personal inclinations would be to continue funding NASA's education initiatives at a robust level. The researcher perceives value in the impact that the programs under threat have as a part of NASA's longstanding commitment to engage the American citizenry in research and learning opportunities and to inspire students from diverse backgrounds to engage with NASA's mission and vision for aeronautics and space exploration. This background as a historian

and educator shapes the researcher's perspective through which the data presented is to be interpreted. Therefore, self-awareness regarding that perspective is critical to the interpretive process in order to accurately reflect the content of the documents under study rather than allow the researcher's beliefs, preferences, or biases to dominate the data analysis process. The researcher's decision to use structural coding in combination with qualitative data analysis software in order to generate an objective coding foundation as well as the utilization of peer debriefing, intended to provide a second perspective on the researcher's approach to the data coding, sorting, and analysis, played an important role in this effort.

Data Analysis

Documents were classified and sorted utilizing QDA Miner Lite, a qualitative document analysis software program, in an attempt to aid in the identification of categories and themes within the materials. Documents were categorized as having been generated during the Obama Administration or the Trump Administration in an effort to compare findings and to consider whether any differences could be perceived. From this data, the researcher was able to summarize emergent themes, draw conclusions, and present recommendations based upon the findings.

Bloomberg and Volpe (2008) describe a four-step process for analyzing data and reporting findings. Step One involves review and exploration of findings in the literature review and collected data to identify and define significant themes or conceptual categories to serve as a foundational framework for data analysis (Bloomberg & Volpe, 2008). Step two involves coding the data, a process described as developing a system of

classification, “the process of noting what is of interest or significance, identifying different segments of the data, and labeling them to organize the information contained in the data” (Bloomberg & Volpe, 2008, p. 198). The researcher utilized structural coding, a practice involving the identification of conceptual phrases representing the topic(s) of inquiry and the application of those conceptual phrases to the data under examination (Saldaña, 2013). These structural codes are utilized to label and then group similarly coded segments in order to perform more detailed analysis (Saldaña, 2013). Further, while the researcher established initial conceptual categories as described above, this coding process followed an inductive approach, allowing coding categories and themes to develop as the research process unfolded. Peer debriefing was utilized to bolster the accuracy of conceptual categories and coding. Steps three and four, as described by Bloomberg and Volpe (2008), address reporting and interpretation of findings. These steps will be addressed in Chapters Four and Five.

Coding. In order to generate an initial list of structural codes for use as a starting point for analysis, the researcher utilized the review of literature of this study to identify key words and concepts that arose with frequency and generality when examining the history of NASA education efforts (Table 1). Initially, the researcher attempted to categorize these codes based upon the research question for which the researcher inferred they were likely to provide insight.

Upon establishing the initial structural code list, the researcher attempted a pilot coding session, utilizing the *FY 2016 president's budget request summary* and, upon completion of this pilot coding attempt, generated a list of additions to each category (Table 2). The document chosen for pilot coding was of no special significance, but was

merely the first document listed in Appendix A. The researcher determined it to be of sufficient length to "get a sense" of the coding process and of the applicability of the initial code list. The additional structural codes added filled in gaps in the initial code list.

Table 1

Initial Structural Codes Drawn from Review of Literature

RQ1 - Impact to Mission	RQ2 – Comparing Administrations	RQ3 - Historical Context
Commitment	Alignment	Disseminate
Compete	Comparison	Engagement
Economic Development	Consolidate	History
Field Centers	Cut	Inspire
Higher Education	Defund	Knowledge
Hub	Domestic Assistance	Outreach
Innovate	Expansion	Scientific Literacy
K-12	Focus	Tradition
Missions	Organization	Vision
Network	Reform	
Partnership	Resources	
Problem Solving	Transition	
Public Relations	Unify	
Relationship		
Research		
Share		
STEM		
Success		
Transdisciplinary Learning		
Understanding		

Table 2

Additional Structural Codes Added During Pilot Coding

RQ1 – Impact to Mission	RQ2 – Comparing Administrations	RQ3 – Historical Context
Learning	Investment	Strategic Planning
Measurement		Expertise
Minorities		Collaboration
Professional Development		
Opportunities		
Workforce Development		
Assessment		
Career		

Following pilot coding, the researcher also determined the initial attempt at categorizing codes by research question of likely impact to be too subjective and likely to color the researcher's further analysis and interpretation of the data. The code list was reorganized to bring consistency to the use of root words and to place the codes into broad functional categories, which served only to provide the researcher with an organizational framework for the coding process rather than to draw any conclusions before analyzing and sorting the results. These organizational categories were:

- Actions
- Characteristics
- Organizational Keywords
- Outputs

This list of structural codes (Table 3) was then applied to all of the documents under study, utilizing the qualitative data analysis software QDA Miner Lite. Each of the 88 documents under review was uploaded into QDA Miner Lite as a .pdf file. Each was then reviewed to ensure accuracy of document conversion. Distortions to document layout and formatting were deemed acceptable by the researcher; however, documents with data loss as a result of the transfer were converted to Microsoft Word files using Adobe Acrobat DC and were then re-uploaded. Additional word forms and synonyms were identified for each of the codes, as necessary, and text retrieval was utilized to code all documents in an objective and replicable manner. See Appendix B for a full list of search terms utilized.

Table 3

Finalized List of Structural Codes

Actions	Characteristics	Organizational Keywords	Outputs
Align	Diversity	Directorate	Career
Assess	Expertise	Domestic Assistance	Economic Development
Collaborate	History	Education	Network
Commit	Knowledge	Higher Education	Opportunity
Compare	Mission	Hub	Professional Development
Compete	Outreach	K-12	Research
Consolidate	Partnership	Shutdown	Resources
Cut	Problem solving	STEM	Scientific Literacy
Develop	Strategic Planning		Workforce Development
Disseminate	Tradition		
Educate	Transdisciplinary Learning		
Eliminate	Vision		
Engage			
Expand			
Focus			
Innovate			
Inspire			
Invest			
Measure			
Organize			
Reform			
Relate			
Remove			
Share			
Succeed			
Transition			
Understand			
Unify			

Sorting. This text retrieval process across the data corpus yielded 10,046 coded segments of text across all of the documents under review. These results were then assessed across four perspectives. When sorting coded materials to identify themes, Adu (2017) suggests considering frequency, generality, meaning and representation. To consider frequency, or a simple count of how many times the code occurred, codes were sorted by frequency of occurrence and percentage makeup of all coded segments. To

consider generality, or how often codes were found across the data corpus, codes were sorted by the number of documents, or cases, in which the code could be found as well as the percentage of total cases in which the code occurred. To begin to understand meaning and representation, codes were sorted by the percentage of change in frequency between the Obama and Trump Administrations. This sorting resulted in 12 codes with all of the following subjectively established characteristics:

- An occurrence count equal to or greater than 80
- A percentage of total codes equal or greater than 1% of all codes
- A case occurrence count equal to or greater than 25 cases
- A percentage of total cases equal to or greater than 25%
- A percentage change in occurrence between administrations of + or – 25%

Additionally, the researcher examined coding that occurred with high frequency and generality but showed little change between administrations in order to consider the meaning and representation of coding that remained more consistent across administrations. This sorting resulted in an additional seven codes meeting all of the same thresholds for frequency and generality but with a percentage change in occurrence between administrations within + or – 25%. The coding results for these 19 high-frequency, high-generality codes are available in Table 4 while full coding frequency results are provided in Appendix C.

By sorting these high-frequency, high-generality codes into groupings based on the researcher's interpretation of the codes' relationships to one another, five broad categories, referred to hereafter as thematic clusters, emerged. The process used to

identify these thematic clusters as well as details of each cluster's content and meaning will be described in greater detail in Chapter Four. The thematic clusters identified are:

- Thematic Cluster One – NASA's Core Education Mission
- Thematic Cluster Two – NASA's Broader Education Vision
- Thematic Cluster Three – Resource Alignment
- Thematic Cluster Four – Agency & External Partners
- Thematic Cluster Five – Assessment & Planning

Table 4

Coding Results – High-Frequency / High-Generality Codes

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Align	173	1.7	34	38.6	-16.0
Assess	167	1.7	36	40.9	65.1
Compete	241	2.4	28	31.8	-90.0
Develop	498	5.0	46	52.3	-42.4
Directorate	216	2.2	39	44.3	-55.0
Diversity	376	3.7	41	46.6	-16.6
Education	1669	16.6	76	86.4	-73.9
Engage	167	1.7	40	45.5	28.8
Focus	178	1.8	40	45.5	40.5
Higher Education	339	3.4	35	39.8	-58.2
Learning	165	1.6	38	43.2	57.8
Mission	404	4.0	50	56.8	-12.1
Opportunity	342	3.4	42	47.7	-21.9
Partnership	118	1.2	28	31.8	-26.5
Research	560	5.6	44	50.0	-67.3
Resources	125	1.2	32	36.4	-18.8
STEM	1939	19.3	86	97.7	48.3
Strategic Planning	737	7.3	69	78.4	-1.9
Workforce Development	159	1.6	42	47.7	3.8

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

As a final step in the coding and sorting process, the researcher broke down the coding results by document source in order to consider triangulation of results among the

various document types. The resulting examination of these subsets of data was utilized to inform findings presented and conclusions drawn regarding thematic clusters and research questions in the coming chapters and will be discussed further in Chapters Four and Five. Document source types for this sorting activity were:

- Budget documents
- NAC STEM Engagement Committee documents and NAC findings
- Strategic planning documents

The subjective criteria developed by the researcher when examining frequency, generality, meaning, and representation had to be adjusted for each subset as the document sample sizes varied widely. Highlighted characteristics for the "Budget Documents" subset (Table 5) included:

- An occurrence count equal to or greater than 100
- A percentage of total codes within the "Budget Documents" equal or greater than 5% of all codes
- A case occurrence count equal to or greater than 3 cases
- A percentage of total cases equal to or greater than 50%
- A percentage change in occurrence between administrations of + or – 75%

Using these subjective criteria, the researcher noted eight codes within the Budget Document subset that stood out among the overall high-frequency, high-generality code list.

Table 5

Coding Results – Budget Documents

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Align	44	2.1	3	50.0	-97.67
Assess	26	1.2	5	83.3	-86.96
Compete	116	5.4	6	100.0	-96.43
Develop	171	8.0	6	100.0	-92.45
Directorate	45	2.1	6	100.0	-84.62
Diversity	112	5.3	6	100.0	-89.11
Education	423	19.8	6	100.0	-90.70
Engage	21	1.0	5	83.3	-60.00
Focus	29	1.4	6	100.0	-61.90
Higher Education	145	6.8	5	83.3	-94.16
Learning	21	1.0	5	83.3	-83.33
Mission	63	3.0	6	100.0	-74.00
Opportunity	101	4.7	6	100.0	-87.78
Partnership	33	1.5	3	50.0	-96.88
Research	257	12.1	6	100.0	-92.92
Resources	22	1.0	3	50.0	-95.24
STEM	345	16.2	6	100.0	-83.45
Strategic Planning	129	6.1	6	100.0	-83.78
Workforce Development	29	1.4	5	83.3	-84.00

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

Highlighted characteristics for the "NAC documents" subset (Table 6) included:

- An occurrence count equal to or greater than 200
- A percentage of total codes within the "NAC Documents" equal or greater than 5% of all codes
- A case occurrence count equal to or greater than 35 cases
- A percentage of total cases equal to or greater than 50%
- A percentage change in occurrence between administrations of + or – 75%

Using these subjective criteria, the researcher noted only two codes within the NAC Document subset that stood out among the overall high-frequency, high-generality code list.

Table 6

Coding Results – NAC Documents

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Align	105	2.2	28	35.4	138.71
Assess	119	2.5	30	38.0	461.11
Compete	91	1.9	20	25.3	-78.67
Develop	246	5.1	37	46.8	79.55
Directorate	125	2.6	30	38.0	-16.18
Diversity	170	3.5	33	41.8	259.46
Education	896	18.6	68	86.1	-48.65
Engage	96	2.0	32	40.5	200.00
Focus	116	2.4	31	39.2	229.63
Higher Education	151	3.1	28	35.4	43.55
Learning	95	2.0	30	38.0	393.75
Mission	248	5.1	41	51.9	61.05
Opportunity	153	3.2	33	41.8	155.81
Partnership	60	1.2	24	30.4	345.45
Research	198	4.1	35	44.3	25.00
Resources	69	1.4	26	32.9	183.33
STEM	1326	27.5	77	97.5	243.48
Strategic Planning	471	9.8	60	75.9	96.23
Workforce Development	82	1.7	34	43.0	115.38

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

Highlighted characteristics for the "Strategic Planning Documents" subset (Table 7) included:

- An occurrence count equal to or greater than 80
- A percentage of total codes within the "Strategic Planning Documents" equal or greater than 5% of all codes
- A case occurrence count equal to or greater than 2 cases

- A percentage of total cases equal to or greater than 50%
- A percentage change in occurrence between administrations of + or – 75%

Using these subjective criteria, the researcher noted only three codes within the Strategic Document subset that stood out among the overall high-frequency, high-generality code list.

Table 7

Coding Results – Strategic Planning Documents

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Align	24	1.5	3	100.0	-80.00
Assess	22	1.4	1	33.3	-100.00
Compete	34	2.1	2	66.7	-93.75
Develop	81	5.0	3	100.0	-82.61
Directorate	46	2.8	3	100.0	-90.48
Diversity	94	5.8	3	100.0	-59.70
Education	350	21.6	2	66.7	-98.55
Engage	50	3.1	3	100.0	-52.94
Focus	33	2.0	3	100.0	-73.08
Higher Education	43	2.6	2	66.7	-92.50
Learning	49	3.0	3	100.0	-36.67
Mission	93	5.7	3	100.0	-67.14
Opportunity	88	5.4	3	100.0	-50.85
Partnership	25	1.5	1	33.3	-100.00
Research	105	6.5	3	100.0	-88.30
Resources	34	2.1	3	100.0	-86.67
STEM	268	16.5	3	100.0	-55.91
Strategic Planning	137	8.4	3	100.0	-65.69
Workforce Development	48	3.0	3	100.0	-22.22

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

Peer Debriefing

Following the completion of the Introduction, Review of Literature, and Methodology sections of this study, a manuscript was provided to a peer reviewer, a colleague enrolled in the same doctoral program as the researcher. Feedback was largely

positive. The peer reviewer asked questions about NASA's budget process and funding sources, which the researcher clarified in revisions to the Introduction. Regarding methodology, the peer reviewer asked questions about the pilot coding process and the rationale for its design. The researcher sought to clarify the pilot coding process with revisions to the manuscript and will also briefly address pilot coding in Chapter Five when considering conclusions and limitations of this study.

Summary

This chapter provided details of the study's research design. The data collection process was also detailed and issues of trustworthiness and reflexivity were explained. The methods of data coding used in this study were described. Structural coding, utilizing qualitative data analysis software, generated results that were analyzed and sorted to generate five categorical themes. Coding was analyzed considering frequency, generality, meaning, and representation. Results were compared across presidential administrations and across document types. Findings regarding the thematic clusters identified will be detailed in Chapter Four. Lastly, the peer debriefing process was detailed and peer feedback regarding methodology was provided. Resulting adjustments to the study were presented.

CHAPTER IV

FINDINGS

Introduction

This chapter details the study's findings. In this chapter, background and context of the research study will be reviewed and further expanded upon. Coding strategies will also be reviewed and the process of developing thematic clusters will be addressed in further detail. Research findings will be presented in detail for each thematic cluster. Feedback from peer debriefing will be detailed and any adjustments made will be highlighted. In conclusion, a brief summary of findings will be presented.

The presentation of findings will be organized around each thematic cluster identified from the sorting of the structural coding. With regard to each cluster, the researcher will:

- Define the thematic cluster,
- Summarize the coding data comprising the thematic cluster
- Explore the relationship between document sources within the thematic cluster,
- Provide supporting evidence from the data comprising the thematic cluster,
- And consider how or if the data comprising the thematic cluster informs the purpose of the study and specific research questions posed.

The purpose of this study was to utilize documentary evidence to explore the impact of Trump era budget proposals on NASA education efforts broadly and on the mission and operations of NASA's Office of Education / STEM Engagement specifically. Research questions to be addressed include:

1. What impact to the mission and operations of the NASA Office of STEM Engagement from the ongoing funding disagreement between the executive and legislative branches can be perceived in NASA's documentary records from the period under study?
2. What meaningful differences can be discerned in how NASA Education / STEM Engagement described its mission, operations, and budgetary needs in the last two years of the Obama Administration in comparison to the four years of the Trump Administration?
3. How do the various proposed and implemented changes to the mission and operations of the Office of STEM Engagement relate to the broader historical mission and operations of NASA education efforts?

The documents analyzed for this study were collected from various public facing NASA websites and cover the period of 2015 through 2020. Thirty documents under review were generated during the final two years of the Obama Administration and 58 documents under review were generated during the four years of the Trump Administration. The documents consisted of portions of NASA executive budget proposals relevant to the Office of Education / STEM Engagement, strategic planning documents specific to the Office of Education / STEM Engagement, and documents presented to the NASA Advisory Council STEM Engagement Committee as well as

recommendations specific to NASA education efforts from the NASA Advisory Council to the NASA Administrator.

Coding and Sorting Revisited

The researcher utilized structural coding as a foundation for the identification of themes and trends present in the data corpus. Because the researcher included dozens of documents and hundreds of pages of material to provide a breadth of information from which to draw conclusions, structural coding provided a starting point for analysis. Namey, Guest, Thairu, and Johnson (2008, p. 141) describe structural coding as a "labeling and indexing device, allowing researchers to quickly access data likely to be relevant to a particular analysis from a larger data set".

It was the researcher's intent to utilize sorting strategies considering not just frequency and generality, but also meaning and representation, as described by Adu (2017), in order to move beyond what could otherwise be a simple quantitative content analysis process. Content analysis in isolation is described by Bloomberg and Volpe (2008, p. 241) as "inherently reductive, particularly when dealing with complex texts, in that it tends too often to simply consist of word counts and often disregards the context within which the text was produced". Bloomberg and Volpe (2008) also argue that frequency of occurrence does not necessarily represent significance in the qualitative coding process. The limitations of the software based structural coding process utilized in this study will be addressed throughout these findings. The use of structural codes and qualitative data analysis software provided an objective and replicable starting point from which to consider the data corpus and to draw findings and conclusions regarding the

research questions posed, but it was intended only as an organizational tool to aid the researcher in considering the available data.

QDA Miner Lite qualitative data analysis software is provided without cost by Provalis Research. By utilizing this software, the researcher was able to designate each document as an individual "case" as well as to tag all of the documents under study with variables such as document source, publication date, document type, and associated presidential administration. The document source (budget document, NAC document, strategic planning document) and presidential administration variables were utilized extensively as part of the data analysis process. QDA Miner Lite was able to provide basic reporting capabilities regarding code frequency and case frequency. The software also provided an export of the master coding list, which the researcher imported to Microsoft Excel for further analysis. Pivot tables were utilized to explore relationships between data points in the master coding list.

Thematic clusters were identified by utilizing an eight-step sorting process defined by Adu (2017):

1. Assess the characteristics of each code,
2. Identify dominant codes in the data,
3. Begin placing dominant codes into context specific clusters,
4. Explore potential relationships between dominant codes and less utilized codes,
5. Continue grouping codes into context specific clusters,
6. Place remaining relevant codes into context specific clusters or create new clusters as necessary,

7. Label each cluster,
8. Sum code frequencies for the cluster.

When assessing the characteristics of each code and determining placement into the appropriate thematic cluster, the researcher considered the four coding characteristics defined by Adu (2017):

- Meaning – what does the code mean, what is its definition?
- Representation – what does this code represent, how does it address the research questions?
- Frequency – how often does the code occur, how many pieces of data are assigned to the code?
- Generality – how many cases are associate with the code, how often does the code occur across differing sources in the data?

Following structural coding and analysis, the researcher identified five thematic clusters across the data corpus. These thematic clusters were:

- Thematic Cluster One – NASA's Core Education Mission
- Thematic Cluster Two – NASA's Broader Education Vision
- Thematic Cluster Three – Resource Alignment
- Thematic Cluster Four – Agency & External Partners
- Thematic Cluster Five – Assessment & Planning

Thematic Cluster One – NASA's Core Education Mission

Definition. Thematic cluster one is defined as NASA STEM Engagement's core educational mission. This cluster focuses on educational roles that the Office of Education / STEM Engagement has traditionally filled throughout its history. The Office of Education's mission statement in 2015 was to "advance high-quality STEM education using NASA's unique capabilities" (National Aeronautics and Space Administration, 2015b, p. 2). The Office of STEM Engagement's mission statement in 2020 was to "engage students in NASA's mission" (National Aeronautics and Space Administration, 2020, p. 3). Specific areas of focus have historically included promotion of student learning and scientific literacy, particularly focused in the STEM fields, college pipeline and workforce development, and teacher training / professional development.

Coding frequency. This cluster comprises the largest share of all coded segments across the data corpus. "Education" and "Higher Education" were referenced less in the four years of the Trump era than during the last two years of the Obama Administration while references to "STEM" and "Learning" increased substantially, as did references to "Workforce Development", though to a lesser extent (Table 8).

Table 8

Coding Frequency - Thematic Cluster One

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Education	1669	16.6	76	86.4	-73.9
Higher Education	339	3.4	35	39.8	-58.2
Learning	165	1.6	38	43.2	57.8
STEM	1939	19.3	86	97.7	48.3
Workforce Development	159	1.6	42	47.7	3.8
Cluster Total	**4271**	**42.5**	**87**	**98.9**	**-28.2**

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

Document Sources. These shifts were less consistent across document sources, with the exception of an across the board decrease in reference to "Education". "Higher Education" was referenced substantially less in Trump Administration budget documents than in the prior Administration. References to "STEM" saw substantial shifts across document types but these shifts were not in a consistent direction. Table 9 illustrates these shifts in coding frequency within this cluster.

Table 9

Directional Change in Frequency – Cluster One

Core Education Mission	All Documents	Budget Documents	NAC Documents	Strategic Plans
Education	↓↓	↓↓	↓	↓↓
Higher Education	↓↓	↓↓		
Learning	↑↑			
STEM	↑↑	↓↓	↑↑	↓
Workforce Development	↑			

Note. Arrows are utilized to represent directional movement in coding frequency. One arrow represents a code that occurred with high frequency and high generality but with a change between administrations of less than + or – 75% while two arrows represent a code that occurred with high frequency and high generality and with a change between administrations of greater than + or – 75%. Shading, from dark to light, is added to emphasize generality across document sources.

Findings & Supporting Evidence. The codes "STEM" and "Education" both occur in greater than 85% of cases under study. The shifts in these terms are largely an example of Bloomberg and Volpe's warning that frequency does not necessarily reflect significance. Under both administrations, NASA used both terms regularly but in 2018 the Office of Education became the Office of STEM Engagement. Where the Obama era Office of Education would use language emphasizing education activities, the Trump era Office of STEM Engagement would describe similar initiatives as STEM engagement activities:

Example of Obama era language. "NASA Education will continue to use competitive processes to identify the most effective, internal STEM education activities and assets across the Agency" (National Aeronautics and Space Administration, 2015a, p. EDUC 4).

Example of Trump era language. "NASA's STEM Engagement community works in close collaboration with NASA's STEM workforce to provide exceptional experiences for students, and with NASA's public engagement workforce to leverage opportunities for reaching students" (National Aeronautics and Space Administration, 2020, p. 2).

The shift in "Learning" is largely a similar example in changing language. Where the Office of Education might have sought to engage students in authentic "educational" experiences, the Office of STEM Engagement seeks to build "a diverse future STEM workforce by engaging students in authentic learning experiences" (Kincaid, 2018, p. 8).

The most compelling shift in this cluster is the change in the focus of NASA's educational activities. At an August 2018 meeting of the NAC STEM Engagement Committee, Associate Administrator for STEM Engagement Mike Kincaid discussed the coming renaming of the Office of Education and laid out the primary focus areas for the new Office of STEM Engagement:

- Create unique opportunities for students and the public to contribute to NASA's work in exploration and discovery,
- Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content and facilities,

- Strengthen public understanding by enabling powerful connections to NASA's mission and work (National Aeronautics and Space Administration, 2018a, p. 2).

Higher education seems to have a diminished role in the reshaped Office of STEM Engagement. This is not to suggest that STEM Engagement does not prioritize higher education. Proposed strategic framework shared with the NAC in 2018 detailed a performance goal to "enhance the vitality and diversity of the nation's STEM and aerospace workforce through investments in higher education" (LaSalvia, 2018, p. 12). However, when comparing strategic planning documents, laying out NASA's education vision and mission, Obama era documents were coded 40 times compared to only three codes in Trump era documents. Additionally, the coding data reveals a corresponding increase in reference to K-12 education from Trump era documents. The "K-12" code fell just below the researcher's subjective cutline of high frequency, high generality, but the code occurrences increased approximately 27% in Trump era documents. This aligns, anecdotally, with an examination of NASA STEM Engagement website, where the majority of web-based resources skew toward younger demographics.

Research Questions. This thematic cluster suggests several areas of consideration regarding the research questions, which will be detailed in the next chapter.

RQ1 – Impact to Mission. Proposed budget cuts may have sharpened STEM Engagement's focus on its core educational mission. NASA's flagship domestic assistance awards, EPSCoR, MUREP, and Space Grant all have significant roles for or interaction with higher education. Elimination of these programs would likely lead to a diminished focus on higher education in the Office of STEM Engagement.

RQ2 – Comparing Administrations. The deemphasis of higher education as a core educational component of NASA STEM Engagement is apparent in the data corpus. Though STEM Engagement continues to reference higher education as a part of its mission, the documents suggest less focus on this learner demographic than was apparent during the Obama Administration.

RQ3 – Historical Context. As detailed in the review of literature, NASA's focus on higher education as a component of its educational mission ebbs and flows throughout NASA's history. A shift toward K-12 STEM engagement, especially in a tight budget climate, would not be unprecedented.

Thematic Cluster Two – NASA's Broader Education Vision

Definition. Thematic cluster two is defined as NASA's broader education vision. This cluster focuses on a wider perspective than STEM Engagement's core mission to promote student learning, educator professional development, and workforce development. An organizational vision is often more aspirational and of wider scope than a mission. During the late Obama Administration, the Office of Education aligned itself with NASA's agency-wide vision to "reach for new heights and reveal the unknown for the benefit of humankind" (National Aeronautics and Space Administration, 2015b, p. 2). In 2020, the Office of STEM Engagement defined its own departmental vision to "immerse students in NASA's work, enhance STEM literacy and inspire the next generation to explore" (National Aeronautics and Space Administration, 2020, p. 3). This cluster contained codes that could be associated with a broader vision, including promotion of research, engagement with diverse populations, and providing opportunities

to interact with NASA and space exploration in ways intended to inspire broad interest in NASA's work.

Coding Frequency. In this cluster, the codes "Develop" and "Research" both experienced substantial decreases between administrations. The codes "Diversity" and "Opportunity" also saw decreases, but to a lesser extent. Only the code "Engage" experienced an increase in occurrence from the Obama Administration to the Trump Administration (Table 10).

Table 10

Coding Frequency - Thematic Cluster Two

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Develop	498	5.0	46	52.3	-42.4
Diversity	376	3.7	41	46.6	-16.6
Engage	167	1.7	40	45.5	28.8
Opportunity	342	3.4	42	47.7	-21.9
Research	560	5.6	44	50.0	-67.3
Cluster Total	**1943**	**19.3**	**58**	**65.9**	**-39.2**

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

Document Sources. Shifts in occurrence were consistent across document sources for this thematic cluster. The codes "Develop", "Diversity", and "Research" occurred with high frequency and high generality, and with substantial shifts in occurrence, across two of three document source categories. "Opportunity" also experienced a decrease in occurrence throughout strategic planning documents (Table 11).

Findings & Supporting Evidence. The consistent directional change in this thematic cluster seems to bolster findings from thematic cluster one suggesting a

tightening of STEM Engagement's mission during this period of budgetary tumult. The code "Develop" often referred in the data to educator professional development, a key part of NASA's overall performance goals. NASA performance goal 2.4.2 from its 2014 strategic plan was to "continue to support STEM educators through the delivery of NASA education content and engagement in education professional development opportunities" (NASA Office of Inspector General, 2015, p. 7). STEM Engagement's current mission has effectively eliminated educator professional development as an organizational goal.

> NASA's work in STEM Engagement is focused on ultimately serving students. It is recognized that providing support and resources to educators and educational institutions is vital to effectively engage students. Ultimately, the beneficiaries of NASA's investments and work in STEM Engagement are students in grades K-12, undergraduate and graduate levels (National Aeronautics and Space Administration, 2020, p. 4).

Table 11

Directional Change in Frequency – Cluster Two

Broader Education Vision	All Documents	Budget Documents	NAC Documents	Strategic Plans
Develop	↓↓	↓↓		↓↓
Diversity	↓	↓↓		↓
Engage	↑			
Opportunity	↓			↓
Research	↓↓	↓↓		↓↓

Note. Arrows are utilized to represent directional movement in coding frequency. One arrow represents a code that occurred with high frequency and high generality but with a change between administrations of less than + or – 75% while two arrows represent a code that occurred with high frequency and high generality and with a change between administrations of greater than + or – 75%. Shading, from dark to light, is added to emphasize generality across document sources.

NASA STEM Engagement continues to set strategic goals to "create unique opportunities for a diverse set of students…build a diverse future STEM workforce…[and] attract diverse groups of students to STEM" (National Aeronautics and Space Administration, 2020, p. 3). However, the elimination of MUREP would be a blow to NASA efforts to engage diverse populations in space exploration. Much of the drop in the code "Opportunity" is also due to the decrease in NASA's budget detailing the value of providing opportunities to connect students, including those at minority serving institutions, with competitive grant opportunities.

The decrease in code occurrence for "Research" can be attributed largely to this same shift in the approach to the budget. As was the case in thematic cluster one, it is not that NASA STEM Engagement no longer values research opportunities. A strategic objective remains to develop and deploy "a continuum of STEM experiences through authentic learning and research opportunities with NASA's people and work" (National Aeronautics and Space Administration, 2020, p. 5). However, the vehicle through which STEM Engagement historically engages other in research is its suite of domestic assistance awards.

- "Space Grant supports and enhances science and engineering education, and research efforts for educators and learners by leveraging the resource capabilities and technologies of over 900 affiliates from universities, colleges, industry, museums, science centers, and State and local agencies" (National Aeronautics and Space Administration, 2016, p. EDUC 9).

- "EPSCoR supports competitively funded awards and provides research and technology development opportunities for faculty and research teams" (National Aeronautics and Space Administration, 2016, p. EDUC 16).
- "NASA's MUREP investments enhance the research, academic, and technology capabilities of [minority-serving institutions] through multi-year awards" (National Aeronautics and Space Administration, 2016, p. EDUC 22).

Research Questions. This thematic cluster suggests several areas of consideration regarding the research questions, which will be explored further in the next chapter.

RQ1 – Impact to Mission. The evidence within thematic cluster two aligns with that of thematic cluster one, suggesting a narrowing of NASA's education mission in the current budgetary environment.

RQ2 – Comparing Administrations. Educator professional development was effectively eliminated as an organizational goal after playing a significant role in the Obama era Office of Education. STEM Engagement also continues to promote engagement in research opportunities while facing the continual threat of the elimination of its primary vehicles to engage the public in such opportunities. STEM Engagement continues, as well, to espouse the value of diversity in STEM education, but the elimination of MUREP would hamper the organization's efforts to engage with diverse populations.

RQ3 – Historical Context. This narrowing of focus, if sustained, would be out of alignment with NASA education's historical role within the agency. NASA

education has a history back to Apollo of promoting research to support agency goals and objectives. MUREP and the other flagship domestic assistance awards have also been a part of NASA's education efforts for almost thirty years, nearly half of the agency's existence.

Thematic Cluster Three – Resource Alignment

Definition. Thematic cluster three, resource alignment, is focused on aspects of the data corpus addressing how STEM Engagement allocated resources, promoted competition to best utilize those resources, and aligned itself with agency and Federal STEM goals and objectives. During the period under study, the Office of Education / STEM Engagement worked to align its goals with those set out by the Federal CoSTEM committee of the National Science and Technology Council. This cluster incorporates those alignment efforts, as well as consideration of budgetary resources and how NASA directed those resources toward student learning. The Trump era Office of STEM Engagement, for example, set out to create "defined objectives and strategies to drive requirements and alignment of all STEM engagement efforts, including programs, projects, activities and products" (National Aeronautics and Space Administration, 2020, p. 2).

Coding Frequency. In this cluster, the most substantial movement was in the code "Compete". Reference to competition, competitive awards, etc. occurred across an equal number of cases during each administration but the code occurred only 22 times during the four years of the Trump Administration compared to 219 occurrences during

only two years of the Obama Administration. “Align” and “Resources” also saw decreases in occurrence between administrations, but to a lesser extent (Table 12).

Table 12

Coding Frequency - Thematic Cluster Three

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Align	173	1.7	34	38.6	-16.0
Compete	241	2.4	28	31.8	-90.0
Resources	125	1.2	32	36.4	-18.8
Cluster Total	**539**	**5.4**	**53**	**60.2**	**-58.9**

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

Document Sources. The most substantial movement across document types occurred in budget documents. This aligns with the Obama Administration promoting the Office of Education’s suite of competitive domestic assistance awards and the Trump Administration proposing their elimination. Code occurrence for “Align” and “Resources” did decline across all document types but nothing of significance stands out when looking at the document sources as subgroups. This is illustrated in Table 13.

Table 13

Directional Change in Frequency – Cluster Three

Resource Alignment	All Documents	Budget Documents	NAC Documents	Strategic Plans
Align	↓			
Compete	↓↓	↓↓		
Resources	↓			

Note. Arrows are utilized to represent directional movement in coding frequency. One arrow represents a code that occurred with high frequency and high generality but with a change between administrations of less than + or – 75% while two arrows represent a code that occurred with high frequency and high generality and with a change between administrations of greater than + or – 75%. Shading, from dark to light, is added to emphasize generality across document sources.

Findings & Supporting Evidence. The code “Align” could arguably be grouped with thematic cluster five, though the researcher made the subjective judgment to place it

in this cluster. The process of aligning resources to meet strategic priorities is seemingly ongoing in most organizations. The Office of Education / STEM Engagement was engaged in a multi-year alignment effort throughout both the Obama and Trump Administrations. A 2015 audit by the NASA Inspector General found that "the Office of Education did not update a 2006 framework document to align with the priorities outlined in the Agency's 2014 Strategic Plan until July 2015" (NASA Office of Inspector General, 2015, p. 3). The audit went on to recommend that OE "issue an Implementation Plan that aligns and remains current with NASA's Strategic Plan, accurately reflects the Office of Education's strategic direction, and includes measures to meet long-term goals and methodologies to gauge success" (Stofan, 2015, p. 12).

The alignment process continued within the Trump era Office of STEM Engagement. After completing its rebranding and reorganization with the completion of an agency prescribed mapping process, the NASA Business Services Assessment (BSA), STEM Engagement's 2020 strategic plan asserted that its current strategy "builds on the direction and solid foundation defined and executed via the NASA Strategy for STEM Engagement (2018-2020), and aligns with the Federal Strategy for STEM Education and Engagement (2018-2023)" (National Aeronautics and Space Administration, 2020, p. 2).

STEM Engagement's domestic assistance awards lie at the heart of efforts to promote competition to utilize NASA resources. "NASA Education will use competitive processes to identify and support the most effective STEM education activities" (National Aeronautics and Space Administration, 2015b, p. 27). When administration budget proposals stopped promoting resource competition and started calling for the elimination

of EPSCoR, MUREP, and Space Grant, reference to the code "Compete" in this cluster dropped.

The "Compete" codes that continued to occur during the Trump era, largely continued to reference these programs facing elimination. The BIG Idea Challenge is one such example. One objective of the BIG Idea Challenge, a NASA competition in partnership with the National Institute of Aerospace, is to "develop a STEM-trained workforce with skills and experience aligned directly with agency mission needs through rigorous competition designed to address technical gaps required to advance space exploration" (Kincaid, 2019, p. 20). This program receives its funding through Space Grant.

Research Questions. This thematic cluster suggests several areas of consideration regarding the research questions, which will be detailed further in the next chapter.

RQ1 – Impact to Mission. While STEM Engagement continued to describe its resource alignment efforts in similar ways across both administrations, the loss of its suite of domestic assistance awards would bring about a substantial change in the mechanisms by which it would carry out its mission.

RQ2 – Comparing Administrations. The elimination of its domestic assistance awards would impact how STEM Engagement would go about promoting competition to engage with NASA resources for scientific literacy and discovery. The change in language usage around the code "Compete" demonstrated the potential impact of this shift between administrations. Faced with budget proposals that eliminated these

resources, STEM Engagement was left to promote EPSCoR, MUREP, and Space Grant more tentatively.

RQ3 – Historical Context. These domestic assistance programs comprise the vast majority of STEM Engagement's budget and these programs have been a part of STEM Engagement's mission for almost half the life of NASA itself. Their elimination would have signaled a dramatic change in NASA's education mission. That outcome, however, is seemingly unlikely to come to fruition as President Biden's initial discretionary spending request for fiscal year 2022 called for a 16% in funding for the Office of STEM Engagement (National Aeronautics and Space Administration, 2021).

Thematic Cluster Four – Agency & External Partners

Definition. Thematic cluster four is defined as centering on partnerships within and outside NASA. Education efforts at NASA have historically been distributed across the Agency as well as reliant on external partners. There have been various attempts to centralize NASA education activities, including during the period under study. This cluster examines the Office of Education / STEM Engagement's relationships with other entities. The Obama era Office of Education described its role as providing "national partnership networks and infrastructure to disseminate NASA Education content and activities developed by the Mission Directorates, Centers/JPL, and education partners" (National Aeronautics and Space Administration, 2015b, p. 17). In this context, examination of the code "Mission" was intended to focus on education in relation to NASA missions rather than NASA's organizational mission.

Coding Frequency. The codes "Directorate" and "Partnership" both occurred with high frequency and high generality and saw substantial declines in occurrence from the Obama Administration to the Trump Administration. The code "Mission" occurred with high frequency and generality and also saw a decrease in occurrence, but to a lesser extent than the other codes (Table 14).

Table 14

Coding Frequency - Thematic Cluster Four

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Directorate	216	2.2	39	44.3	-55.0
Mission	404	4.0	50	56.8	-12.1
Partnership	118	1.2	28	31.8	-26.5
Cluster Total	**738**	**7.3**	**52**	**59.1**	**-29.2**

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

Document Sources. Consistent shifts in occurrence are not evident across document sources for this cluster. While the codes "Directorate" and "Partnership" occurred with high frequency and generality across all document types, substantial shifts were not concentrated in particular document source types. References to "Mission" decreased in strategic planning documents but increased across the NAC document group (Table 15).

Table 15

Directional Change in Frequency – Cluster Four

Agency & External Partners	All Documents	Budget Documents	NAC Documents	Strategic Plans
Directorate	↓↓			
Mission	↓		↑	↓
Partnership	↓↓			

Note. Arrows are utilized to represent directional movement in coding frequency. One arrow represents a code that occurred with high frequency and high generality but with a change between administrations of less than + or – 75% while two arrows represent a code that occurred with high frequency and high generality and with a change between administrations of greater than + or – 75%. Shading, from dark to light, is added to emphasize generality across document sources.

Findings & Supporting Evidence. NASA education activities have been distributed across the agency throughout its history. The Obama era Office of Education sought to be a coordinating body for those activities. OE "supports a coherent framework for engaging STEM education learners, educators, and institutions; while reducing program fragmentation and ensuring that the OE, Centers and Mission Directorates implement a strategically integrated education portfolio" (National Aeronautics and Space Administration, 2015a, p. EDUC 3). STEM Engagement's approach in 2020 was not dissimilar, though shifts could be perceived in making sure OSTEM aligns with mission needs, rather than trying to coordinate efforts from NASA Headquarters. This "architecture is designed to enable relevant student contributions to NASA's mission and work, which relies on mission drivers and requirements from NASA's Mission Directorates" (National Aeronautics and Space Administration, 2020).

One apparent shift in this cluster was the phaseout of the STEM Education and Accountability Programs (SEAP). Under the Obama Administration, SEAP investments were intended to "focus on NASA-unique STEM engagement experiences and activities; represent all NASA mission directorates; engage with underserved and underrepresented communities/institutions; and support key NASA infrastructure components to enable portfolio coordination approaches" (National Aeronautics and Space Administration, 2015b, p. 19). SEAP was designed to connect NASA partners, "including youth-serving organizations, higher education institutions, minority serving institutions, community colleges, NASA Visitor Centers, museums, and planetaria" to the agency's missions and resources (National Aeronautics and Space Administration, 2015b, p. 19).

SEAP was replaced in 2018 by Next Gen STEM, an Office of STEM Engagement effort to develop "STEM products and opportunities that provide a platform for students to contribute to NASA's endeavors in exploration and discovery" (May, 2019d). Next Gen STEM's focus is on providing digital resources for use by external audiences. During the Obama Administration, SEAP had a unique line item in executive budgets and was slated for shutdown in the initial Trump Administration budget proposals. Next Gen STEM does not have a unique line item in subsequent budget documents and its funding architecture is less clear, though it can be inferred that its costs have been lowered to the point that it is sustainable within STEM Engagement's general operating expenses.

Efforts to tie STEM Engagement activities to NASA missions can be seen in the current Office of STEM Engagement. For example, in fiscal year 2020 STEM Engagement supported Artemis STEM Challenges, the celebration of the International Space Station's 20th anniversary, Commercial Crew activities, Earth Day celebrations, and the Mars 2020 mission (Kincaid, 2019, p. 12).

Research Questions. This thematic cluster suggests several areas of consideration regarding the research questions, which will be detailed in the next chapter.

RQ1 – Impact to Mission. This cluster relates both to the cluster one and two trends of a tightening focus in a constrained budget environment as well as cluster three and efforts to align resources with agency objectives. Finally, this cluster also ties to cluster five and STEM Engagement's efforts to assess performance.

RQ2 – Comparing Administrations. A criticism of the Obama era Office of Education was its inability to measure success. While the coding indicates less

frequency of reference to the directorates and NASA missions, perhaps due to the elimination of STEM Engagement's SEAP efforts to connect partners to NASA's resources, the Trump era Office of STEM Engagement has placed significant emphasis on aligning STEM Engagement activities to agency/mission/directorate needs.

RQ3 – Historical Context. The cyclical nature of education's role and place in the agency is as old as NASA itself. Shifts in how the Office of STEM Engagement relates to other agency directorates, etc. are not unusual. STEM Engagement's need to take a less ambitious role in connecting with external partners is also not unusual in a constrained budget climate.

Thematic Cluster Five – Assessment & Planning

Definition. Thematic cluster five is defined as assessment and planning. The codes within this cluster emphasize strategic planning efforts, areas of STEM Engagement focus, and the processes in place for assessing success. This cluster highlights an area of tension in the transition from the Office of Education to the Office of STEM Engagement. While the Obama era OE emphasized its role as an assessment hub for agency-wide education efforts, the Trump Administration's first executive budget calling for OE's elimination argued that "outcome-related data demonstrating program effectiveness has been insufficient to assess the impact of the overall OE portfolio" (National Aeronautics and Space Administration, 2017, p. EDUC 2).

Coding Frequency. This thematic cluster provides the only example of substantial increases in coding occurrence in the Trump Administration in comparison to the last two years of the Obama Administration. The codes "Assess" and "Focus" both

experienced substantial increases in occurrence while occurrences of the code "Strategic Planning", referenced in almost 80% of all cases across the data corpus, remained almost flat between administrations (Table 16).

Table 16

Coding Frequency - Thematic Cluster Five

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Assess	167	1.7	36	40.9	65.1
Focus	178	1.8	40	45.5	40.5
Strategic Planning	737	7.3	69	78.4	-1.9
Cluster Total	**1082**	**10.8**	**75**	**85.2**	**12.6**

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

Document Sources. Nothing stands out across document sources when examining the codes "Assess" and "Focus". These terms increased in frequency across document types on the whole but there were no substantial shifts within particular document types. References to "Strategic Planning" decreased in budget documents and strategic planning documents, but increased substantially in the collection of NAC documents. This is illustrated in Table 17.

Table 17

Directional Change in Frequency – Cluster Five

Assessment & Planning	All Documents	Budget Documents	NAC Documents	Strategic Plans
Assess	↑↑			
Focus	↑↑			
Strategic Planning	↓	↓↓	↑↑	↓

Note. Arrows are utilized to represent directional movement in coding frequency. One arrow represents a code that occurred with high frequency and high generality but with a change between administrations of less than + or – 75% while two arrows represent a code that occurred with high frequency and high generality and with a change between administrations of greater than + or – 75%. Shading, from dark to light, is added to emphasize generality across document sources.

Findings & Supporting Evidence. As referenced previously, NASA's Inspector General criticized the Office of Education in 2015 for being unreasonably slow to align its operational framework with current agency priorities. "Furthermore, the updated framework did not include measurable long-term goals that address the Nation's need to increase the number of students who earn advanced degrees in preparation for STEM careers" (NASA Office of Inspector General, 2015, p. 2). Strategic planning and assessment were both central to the dialogue that took place within the NAC STEM Engagement Committee throughout the four years of the Trump Administration.

Also, as previously referenced, the lack of a productive assessment framework was the reason cited in NASA's FY17 budget request for the proposed elimination of the Office of Education. "Given these challenges and current fiscal constraints, the NASA budget terminates OE" (National Aeronautics and Space Administration, 2017, p. EDUC 3). The BSA mapping project, an agency-wide initiative and a process that stretched across both administrations, provided OE / STEM Engagement an opportunity to address these concerns while Congress shielded the department from significant cuts. "The Education and Outreach BSA Core Team will assess current agency capability to (a) enable NASA to advance high-quality STEM education using NASA's unique capabilities and (b) inspire, inform and engage the public to promote interest and participation in NASA's mission" (Tenney, 2016, p. 6).

The document source directional change in this cluster illustrates how strategic planning discussions shifted to the NAC STEM Engagement Committee as these efforts were ongoing. STEM Engagement now includes as a core design principle in all of its initiatives that those initiatives "establish outcomes and define corresponding metrics and

measures to demonstrate success" (National Aeronautics and Space Administration, 2020, p. 7). The NAC shared this finding in March 2018 stating, "the actions taken by the Office of Education to improve the strategic alignment, implementation, and evaluation of their STEM engagement activities have happened swiftly and are impressive" (NASA Advisory Council, 2018).

Research Questions. This thematic cluster suggests several areas of consideration regarding the research questions, which will be explored further in the next chapter.

RQ1 – Impact to Mission. The inability to better assess program effectiveness served as a direct threat to OE / STEM Engagement's mission. The BSA mapping process, already underway by the time OE's elimination was proposed, provided the organization an opportunity to address deficiencies and, by extension, to seemingly justify its continuing operations.

RQ2 – Comparing Administrations. The lack of effective assessment was the stated reason for the proposed elimination of OE. STEM Engagement in the Trump era engaged in a reorganization and rebranding to improve assessment and to narrow focus on its core mission to avoid elimination. The BSA mapping activities, not dictated by a particular presidential administration but by agency mandate, served nonetheless as a perfectly timed response to the criticisms of ineffectiveness leveled at the department.

RQ3 – Historical Context. The heavy emphasis on planning and assessment during this period is likely to benefit the Office of STEM Engagement regardless of any change in direction under the Biden Administration. The BSA mapping

project and processes put in place to ensure project development includes assessment planning should provide STEM Engagement with a firm foundation for operation.

Peer Debriefing

Following initial gathering of the research findings, a draft of this study was provided to the study's peer debriefer. While the interpretation of the coding and sorting process and the development of research findings was designed to be of a subjective nature, the peer debriefer was provided instructions to review the findings for signs of overt bias on the part of the researcher as well as to provide any additional feedback. Feedback was positive. The peer debriefer requested clarification regarding the definition of some key terms, including providing a more transparent definition of the term "thematic cluster". The researcher addressed these requests through subsequent revisions to the manuscript. The peer debriefer did not cite any examples of overt researcher bias within the findings.

Summary

This section provided details of the study's research findings. The process used to develop thematic clusters was described in detail. Each thematic cluster was defined and coding frequency data specific to the cluster was reviewed. Variations in the data across document sources were considered. Supporting evidence was provided for each thematic cluster within the research findings. A summary table (Table 18) is provided here to offer a snapshot highlighting these findings resulting from the coding and sorting process.

Peer debriefing was again utilized to provide the researcher with an additional perspective on the results of the coding and sorting efforts. Feedback provided was

detailed and adjustments made to the study were highlighted. Finally, each thematic cluster was considered in relation to the research questions. These relationships will be further considered in the study's conclusion.

Table 18

Summary of Findings

Thematic Cluster	Meaning	Evidence from the Data
One – NASA's Core Education Mission	Promoting STEM literacy, pipeline from K-12 to college, workforce development, and educator professional development.	The data suggests a narrowing of NASA's education mission. References to NASA's role in higher education, while still present, decreased under President Trump. Alignment with CoSTEM goals under Trump Admin focused more on pre-college student learning.
Two – NASA's Broader Education Vision	Immerse the public in space exploration, inspire learners to engage with NASA, connect to diverse populations, promote research	As in cluster one, the data suggests a narrowing of NASA's education mission. STEM Engagement's decreased reference to research opportunities, professional development, and diversity all support this assertion. STEM Engagement continued to describe a focus on diversity and research opportunities while budgets called for elimination of primary drivers.
Three – Resource Alignment	Align with Federal STEM objectives, promote competition to surface the best results, utilize agency resources effectively	While alignment and allocation efforts were ongoing across NASA Education / STEM Engagement throughout the period under study, the potential loss of domestic assistance awards affected STEM activities under the Trump Admin. Decreased reference to competition for resources was a direct result of less elaboration on EPSCoR, MUREP, and Space Grant activities.
Four – Agency & External Partners	STEM Engagement's relationships with agency and external partners. Promotion of education initiatives through Directorates, NASA missions, and outside entities	STEM Engagement shifted slightly into more of a mission support role than that of a coordinating role with regard to its relationship with directorates, missions. The phaseout of SEAP seems to have contributed to decrease in dialogue regarding external partners. Next Gen STEM replaced SEAP and focuses largely on digital resources.
Five – Assessment & Planning	Evaluation of strategic planning efforts to achieve goals established by resource alignment processes and assessment of program effectiveness to measure success	Partially in response to the threat of elimination, increased emphasis on assessment and planning took place in the Trump era Office of STEM Engagement. Some of the improvement processes were already in motion prior to proposed elimination, but this focus on assessment and planning is likely to benefit OSTEM in the future.

CHAPTER V

CONCLUSIONS

Introduction

The purpose of this study was to consider the impact of proposed budget cuts to the NASA Office of Education / STEM Engagement throughout the four years of the presidency of Donald J. Trump. The researcher sought to explore the potential impacts to the Office of Education / STEM Engagement's mission and to NASA education efforts as a whole. Through the examination of documentary artifacts produced throughout the Trump presidency as well as documents produced in the prior two years of the concluding Obama presidency, the researcher hoped to reveal any shifts in NASA's description of its education activities. By examining NASA's history, the researcher hoped to recognize how current education activities relate to NASA's overall education efforts throughout its more than 60-year history.

The researcher analyzed documents specific to NASA STEM Engagement's proposed and actual budgets, NASA STEM Engagement strategic planning documents, and meeting materials documenting NASA reporting to the NASA Advisory Council STEM Engagement Committee as well as recommendations from the NAC STEM Engagement Committee to the NAC and, by extension, the NASA

Administrator in an effort to code and triangulate these document sources to address these research questions:

1. What impact to the mission and operations of the NASA Office of STEM Engagement from the ongoing funding disagreement between the executive and legislative branches can be perceived in NASA's documentary records from the period under study?
2. What meaningful differences can be discerned in how NASA Education / STEM Engagement described its mission, operations, and budgetary needs in the last two years of the Obama Administration in comparison to the four years of the Trump Administration?
3. How do the various proposed and implemented changes to the mission and operations of the Office of STEM Engagement relate to the broader historical mission and operations of NASA education efforts?

The following section summarizes the researcher's conclusions after analyzing findings from this qualitative case study. The thematic clusters identified in the data corpus will be utilized as a lens through which to consider each research question. Initial assumptions and limitations will be revisited. The researcher will also share recommendations and conclusions.

Analysis, Interpretation, and Synthesis of Findings

Research Question One. The data suggests that the Office of Education / STEM Engagement used the four years of the Trump Administration to examine its organizational structure and to tighten its focus in the face of financial cuts. Data from

thematic cluster one suggests a shift toward learning initiatives targeting K-12 and away from higher education. This is not to suggest that STEM Engagement does not seek to engage undergraduate and graduate students in STEM. The most significant mechanism available to STEM Engagement, however, to engage undergraduate and graduate students in learning opportunities is its suite of domestic assistance awards.

The potential loss of EPSCoR, MUREP, and Space Grant cast a shadow over education efforts throughout this period. In March 2018, the directive from Acting Administrator Robert Lightfoot in the face of the first proposed budget elimination and shutdown of education activities was to keep working and to keep implementing the changes laid out by the BSA (National Aeronautics and Space Administration, 2018b). This seems to have been the mantra throughout the Trump presidency.

Thematic cluster two seemed to support the theme detected in cluster one, that of a tightening focus in a challenging budget climate. STEM Engagement now asserts that students are its core audience, though it has a long history of educator professional development as well. Those efforts, though, are not a primary part of STEM Engagement's mission at this time. Declines in STEM Engagement's reference to diversity and to research are particularly troubling but also likely a result of the budget climate. Engaging diverse populations in STEM literacy and promoting research opportunities that support space exploration both continue to be part of STEM Engagement's mission. Once again, the department is hampered in promoting these efforts when primary drivers like MUREP and EPSCoR are slated for elimination year in and year out.

The same is true for thematic cluster four and its relation to this research question. STEM Engagement has been limited in its ability to align resources to meet agency objectives when it is perpetually unclear what resources will be available to the organization each year. STEM Engagement seemingly had a lot less to say about promoting competition to engage students with unique NASA resources when the organization had to operate as though the mechanisms for such competition would be phased out.

Thematic cluster five provides an example of STEM Engagement using the moment to the best of its collective ability. The Office of Education had been targeted as struggling to align its objectives with NASA's strategic goals and with measuring its success in achieving its mission and these criticisms predated the Trump Administration. STEM Engagement was able to utilize the BSA mapping process as a mechanism to address these concerns. With the process completed in the second half of the Trump presidency, time will begin to reveal how successful these efforts may have been.

Research Question Two. The Office of STEM Engagement was renamed and refocused to draw a sharp distinction from the Obama era Office of Education. Leadership in STEM Engagement asserted that the shift was intended to make sure that Congress understood that NASA education efforts were unique, not a duplication of other education offices across the Federal government (Kincaid, 2018). While nothing in the documents studied suggests the name change was actually more targeted at executive, rather than legislative leadership, contemporary news reporting would suggest otherwise (Foust, 2017). The rebranding certainly appears to have been an effort to avoid the

attention of the Trump Administration rather than that of Congress, which continued to support STEM Engagement in the media and with budget votes (Foust, 2020).

Research question two draws on many of the same themes perceived in research question one. It makes sense to the researcher that potential budgetary impacts from the proposed cuts of the last four years would intertwine with distinctions drawn between the Obama and Trump eras in NASA education. Those distinctions are largely the result of STEM Engagement efforts to distinguish itself as a new and unique entity. Thematic clusters one and two both support the idea that STEM Engagement was reorganized to tighten the department's focus on its core education mission and to emphasize its role in connecting young leaners to space exploration and STEM literacy resources. The seeming de-emphasis on higher education aligns with this effort, as do the lessened discussions of research and diversity. STEM Engagement's shift to all but eliminate its focus on educator professional development is also a fairly significant change from the Obama era Office of Education.

Thematic clusters three and four suggest an organization working to align itself to agency needs and to play a less visible role in coordinating education activities, unlike the Obama era Office of Education. For better or worse, OE promoted itself as the coordinating body for NASA education efforts and received harsh criticism when it fell short in its efforts to fulfill that role. STEM Engagement, meanwhile, seems to have been limited in its ability to promote its resources and partnerships with its programs designed to serve those functions under threat of elimination.

The most positive, or potentially positive result of the last four years was STEM Engagement's effort to reorganize under the framework of the BSA and to focus on effective assessment. STEM Engagement reports having completed a successful mapping process and also reports that the department is now well positioned to measure the success of NASA education efforts (National Aeronautics and Space Administration, 2019b). Regardless of changes brought on by new leadership under President Biden, these efforts should serve the department well.

Research Question Three. The researcher set out to understand where these changes and proposed changes fit into the history of NASA education efforts as well as to understand the trajectory of the department. If the Trump Administration had succeeded in eliminating funding for EPSCoR, MUREP, and Space Grant then the situation would be altered significantly. As it stands, with those budgetary changes having never come to pass, it seems likely that this era of NASA education will blend more into the rest of the agency's history of change and reinvention while maintaining a focus on its core mission to explore our solar system and to inspire others by doing so.

Ebbs and flows in which NASA focuses more or less on higher education or K-12, more or less on teacher training, or even more or less on coordination of efforts with the mission directorates all have historical precedent. NASA's education efforts have been branded and rebranded and the department has changed organizational homes multiple times in just over 60 years of NASA history. The agency has also struggled throughout its history to coordinate education efforts that occur across field centers, mission directorates, and agency partners. The modern Office of Education / STEM Engagement continues to share in those same struggles. The cancelation of EPSCoR,

MUREP, and Space Grant, however, would represent the abandonment of thirty years of efforts to promote research, to engage with universities and other outside entities to educate and inspire, and to engage underserved populations in STEM opportunities. These changes would have foundationally altered NASA education efforts. Fortunately, they have not come to pass and appear unlikely to do so under the Biden Administration (National Aeronautics and Space Administration, 2021).

Revisiting Assumptions

Assumption One. It was assumed that coding and triangulation of data across three distinct document types; budget documents, strategic planning documents, and reports to and by the NAC STEM Engagement Committee would provide sufficient information from which to draw inferences, identify themes, and to reach conclusions about the period of organizational change during the Trump era in NASA STEM Engagement.

The researcher perceives this as having been a successful, if limited mechanism for considering the research questions. Budget documents, meeting minutes, presentation materials, audits, strategic planning documents, etc. all tell pieces of a larger story. The researcher believes that the process of structural coding using qualitative data analysis software provided a framework for considering that story and that the thematic clusters surfaced provided context for the exploration of this period of STEM Engagement's history. Rich detail and interpretation that would have resulted from participant interviews was lacking and would have likely provided more validation or refutation of the researcher's conclusions.

Assumption Two. It was assumed that, despite the transition to the Biden Administration, the necessary NASA documents produced during both the Obama and Trump Administrations, publicly available at the time of this study's proposal and essential to the document analysis process utilized, would remain publicly available and accessible throughout the duration of this research.

Access to documents was never at issue during the course of this study. Indeed, the trove of data from the NASA Advisory Council as well as the other resources utilized, was readily available because of NASA's transparency, at least with regard to government documents. Again, the researcher would have preferred access to NASA personnel to perform interviews rather than to rely on the documentary evidence alone, but the availability of these NASA documents made this study possible.

Assumption Three. Because the organizational and budgetary changes and proposed changes coincided with a new presidential administration and leadership changes within NASA, it was assumed that political biases might play a role in the manner in which information was presented as well as the researcher's interpretation of data.

The researcher put in place efforts to recognize and to prevent biases from impacting the research findings. The use of computer assisted qualitative data analysis software and the engagement of a peer reviewer were both employed to limit bias on the part of the researcher. Unfortunately, this research design was not intended to uncover what biases might be presented by the documents themselves. Without participant

interviews, a study utilizing only documents can only present a portion of the full picture of this period in NASA's history.

Limitations and Recommendations

While the researcher believes that this study succeeded in providing an overview of this period of transition in NASA education efforts and that the qualitative document analysis conducted yielded insights about NASA STEM Engagement's response to this period of significant budgetary disruption, the researcher presents here a series of recommendations for further study.

There are a number of variations on this research design which may yield additional or more detailed results. First, pilot coding in order to fully develop the structural code list might be done utilizing a random sample of the documents under study or one of each document type as possible alternatives rather than the researcher's decision to utilize a single document from the data corpus.

Secondly, the use of qualitative data analysis software to perform initial coding placed a heavy emphasis on code frequency and generality. This runs the risks described by Bloomberg and Volpe (2008) that content analysis too dependent on counting can be reductive and yield results that do not necessarily bear significance. On occasion, comparing documents across administrations felt a bit like comparing the communication patterns of President Obama and President Trump themselves. Most would agree that President Obama was a more verbose public speaker than President Trump, but a lengthy Obama speech and a Trump tweet both conveyed the weight of the presidency. Strategic planning documents provide an example of this in the context of this study. The 2015

NASA Education Implementation Plan was 56 pages long while the 2018 and 2020 NASA Strategy for STEM Engagement documents were a combined 12 pages. Counting code frequency when comparing these two can lead to faulty conclusions. This is why the researcher attempted to use a large sampling of documents to offset this concern. It is, however, a limitation to the approach utilized in this study. Additionally, other coding methodologies, more reliant on the identification of concepts rather than terms, could also reduce the risk of reductivism.

Ultimately, the researcher recommends the pursuit of a research design more in line with that described in Chapter One's Delimitations section. This study would have been well suited as a phenomenological study utilizing interviews with STEM Engagement personnel. Perhaps with a change in presidential administrations, another researcher will have more success identifying willing research participants.

Conclusions

This research study set out to explore the impact of potential budget cuts on the NASA Office of STEM Engagement, hoped to identify distinctions to be drawn between the concluding two years of the Office of Education under President Obama and the four-year term of President Trump, and sought to place this moment in STEM Engagement's operations in the larger context of NASA's history of education outreach. Document analysis suggested a narrowing of STEM Engagement's mission. STEM Engagement seemed to de-emphasize operations key to its historic mission and driven by its domestic assistance awards as those awards faced the threat of elimination throughout the period under study. While the elimination of those awards would have represented a sizeable

shift in NASA's history of education outreach, those proposed executive budgets never came to fruition. STEM Engagement's focus on assessment and strategic planning during this period of tumult should serve it well as it awaits the leadership, guidance, and directives of a new presidential administration.

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APPENDICES

APPENDIX A

List of Materials Included in Document Analysis

Budget Documents

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APPENDIX B

Structural Codes with Synonyms and Additional Word Forms

Actions					
Align	aligned	alignment	aligns		
Assess	assessed	assessing	assessment		
Collaborate	collaborated	collaborates	collaborating	collaboration	
Commit	commited	commiting	commitment	commits	
Compare	compared	compares	comparing		
Compete	competed	competes	competing	competition	competitive
Consolidate	consolidated	consolidates	consolidating	consolidation	
Cut	decrease	reduce	reduction		
Develop	developed	developes	developing	development	
Disseminate	disseminated	disseminating	dissemination		
Educate	educates	educating			
Eliminate	eliminated	eliminates	eliminating		
Engage	engaged	engages	engaging		
Expand	expanded	expanding	expands	expansion	
Focus	focused	focuses	focusing		
Innovate	innovated	innovates	innovating	innovative	
Inspire	inspiration	inspired	inspires	inspiring	
Invest	invested	investing	investment	invests	
Measure	measured	measures	measuring		
Organize	organization	organized	organizes	organizing	
Reform	reformation	reformed	reforming	reforms	
Relate	related	relates	relating	relationship	

Remove	removal	removed	removes	removing		
Share	shared	shares	sharing			
Succeed	success	successes	successful			
Transition						
Understand	understanding	understands	understood			
Unify	unified	unifies	unifying	unites	uniting	unity
Characteristics						
Diversity	diverse	minority	underrepresented	underserved		
Expertise	expert					
History	historic					
Knowledge						
Learning	learn	learned	learns			
Mission						
Outreach						
Partnership	partner	partnered	partnering	partners		
Problem solving	problem-solving					
Strategic Planning	plan	planning	strategic	strategize	strategy	
Tradition						
Transdisciplinary Learning						
Vision						
Organizational Keywords						
Directorate	directorates					
Domestic Assistance	domestic					
Education						
Higher Education	college	colleges	higher	universities	university	
Hub						
K-12	child	children	elementary	highschool	middle school	schools
Shutdown						
STEM						
Outputs						
Career						

Economic Development	economic	economies	economy
Network	networking	networks	
Opportunity	opportune	opportunities	
Professional Development	professional		
Research			
Resources	resource	resourced	resourcing
Scientific Literacy	literacy		
Workforce Development	workforce		

APPENDIX C

Coding Frequency Chart

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Align	173	1.7	34	38.6	-16.0
Assess	167	1.7	36	40.9	65.1
Career	81	0.8	15	17.0	-73.4
Collaborate	76	0.8	23	26.1	-53.8
Commit	6	0.1	5	5.7	0.0
Compare	11	0.1	6	6.8	-16.7
Compete	241	2.4	28	31.8	-90.0
Consolidate	73	0.7	12	13.6	-71.9
Cut	15	0.1	6	6.8	-63.6
Develop	498	5.0	46	52.3	-42.4
Directorate	216	2.2	39	44.3	-55.0
Disseminate	8	0.1	6	6.8	66.7
Diversity	376	3.7	41	46.6	-16.6
Domestic Assistance	7	0.1	7	8.0	33.3
Economic Development	30	0.3	11	12.5	-84.6
Educate	25	0.2	13	14.8	-52.9
Education	1669	16.6	76	86.4	-73.9
Eliminate	4	0.0	4	4.5	200.0
Engage	167	1.7	40	45.5	28.8
Expand	40	0.4	17	19.3	-62.1
Expertise	60	0.6	22	25.0	40.0

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
Focus	178	1.8	40	45.5	40.5
Higher Education	339	3.4	35	39.8	-58.2
History	11	0.1	9	10.2	166.7
Hub	1	0.0	1	1.1	#N/A
Innovate	28	0.3	12	13.6	-44.4
Inspire	68	0.7	29	33.0	34.5
Invest	85	0.8	26	29.5	-33.3
K-12	95	0.9	31	35.2	26.2
Knowledge	37	0.4	15	17.0	-67.9
Learning	165	1.6	38	43.2	57.8
Measure	95	0.9	21	23.9	106.5
Mission	404	4.0	50	56.8	-12.1
Network	47	0.5	21	23.9	-37.9
Opportunity	342	3.4	42	47.7	-21.9
Organize	19	0.2	8	9.1	-88.2
Outreach	37	0.4	16	18.2	-52.0
Partnership	118	1.2	28	31.8	-26.5
Problem Solving	8	0.1	7	8.0	66.7
Professional Development	44	0.4	14	15.9	-87.2
Reform	5	0.0	4	4.5	-33.3
Relate	97	1.0	17	19.3	-81.7
Remove	3	0.0	2	2.3	-100.0
Research	560	5.6	44	50.0	-67.3
Resources	125	1.2	32	36.4	-18.8
Scientific Literacy	23	0.2	14	15.9	-8.3
Share	106	1.1	21	23.9	121.2
Shutdown	6	0.1	6	6.8	#N/A

Code	Count	% Codes	Cases	% Cases	% Change Obama to Trump
STEM	1939	19.3	86	97.7	48.3
Strategic Planning	737	7.3	69	78.4	-1.9
Succeed	76	0.8	34	38.6	5.4
Tradition	1	0.0	1	1.1	-100.0
Transdisciplinary Learning	12	0.1	7	8.0	#N/A
Transition	9	0.1	7	8.0	#N/A
Understand	57	0.6	30	34.1	100.0
Unify	8	0.1	6	6.8	-85.7
Vision	59	0.6	25	28.4	-9.7
Workforce Development	159	1.6	42	47.7	3.8

Note. Shading is utilized to aid in data visualization. Dark green indicates a code which occurred with high frequency and generality and with a high change in occurrence. Lighter shading indicates a decreasing number of met conditions.

VITA

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